Nature, March 23, 1911]

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" *To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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Reviews and Our Bookshelf.

NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

THURSDAY, NOVEMBER 3, 1910.

THEORETICAL MECHANICS.

Cours de Mécanique Rationelle et Experimentale, spécialement écrit pour les physiciens et les ingénieurs, conforme au programme du certificat de mécanique rationelle. By Prof. H. Bouasse. Pp. 692. (Paris: Ch. Delagrave, n.d.) Price 20 francs.

A NOTICEABLE feature of this treatise on theoretical mechanics is the large number of practical examples discussed. The majority of these are of a physical rather than an engineering character, some of them dealing with physical apparatus. Investigations of oscillations under various conditions occupy a considerable part of the book. The author claims mechanics as a branch of physics, the first chapter of physics, and aims at supplying a treatise of the kind which is likely to be useful to those whose interest in the subject depends on its applications to practical physical questions. He protests against the unpractical character of the French treatises on the subject written by mathematicians, and of the questions asked in examinations.

To a considerable extent the book fulfils its aim. It contains a great deal of information (including some useful fragments of mathematics connected only incidentally with mechanics), and it is for the most part written in a pleasant, lucid style, slightly marred by occasional eccentricities. As much of the theory is included as is generally needed for practical use, no attempt being made to restrict the use of mathematical methods. There are, however, some slips. An important one, which should puzzle a reader unacquainted with the subject, occurs in the investigation of Euler's equations. Occasionally also the methods adopted are clumsy or unduly ponderous.

A case of ponderous treatment of theory occurs in so simple a matter as the investigation of the composition of angular velocities. The author hints at reasons, not fully explained, which appear to him to make it desirable, "in order to avoid all difficulty," to derive the composition of angular velocities from the study of a succession of finite angular displacements. He goes on to discuss the theory of this at considerable length, a rather tiresome procedure.

Now the meaning of the composition of simultaneous motions is not a very easy thing to understand, and ought to be a matter for clear definition. Without a definition, expressed or implied, it is unintelligible. Prof. Bouasse does not give a definition of it, but he implies that the resultant motion is to be calculated from the limiting case of successive displacements when these are small. Such a method of treatment is not uncommon, but surely the method afforded by the consideration of relative motions taking place simultaneously is preferable. In the case of angular velocities, the mounting of a body in gimbals provides the mechanism which is needed for a clear conception of the composition, the angular velocity of the body being the resultant of its angular velocity relative to an intermediate base and the angular velocity of this base relative to the final one. The difference between the two methods of treatment is not solely one of style. The resultant is given by either method, and an experienced reader would pay no attention to any other feature of the arrangement adopted. But inexperienced readers, for whom the more elementary parts of a book like this must be intended, might reasonably be puzzled by perceiving that successive displacements do not give results identical in all respects with what is proposed. The path of a point of the moving body remains a zigzag up to the limit, and if the length of this path were the thing to be calculated the method of successive displacements would not give a correct result. If the limit of successive displacements is to be regarded as the definition of the composition, it ought to be a correct method for calculating everything about the motion.

It might be expected that a professor of physics, who regards mechanics as a branch of his subject, would give some attention in detail to the physical laws which form the basis of his calculations. Our author, however, frankly ridicules the idea of questioning the truth of them, and does not even take the trouble to state them correctly. He professes to deal with the subject from the beginning, but any reader

who had no previous knowledge of it would be bewildered. No pure mathematician could be more careless as to what the equations which he desires to write down are based upon, or show less interest in the question whether the results to which they lead are verified. Moreover, he does not explicitly refer to the base, relative to which the motions studied are reckoned, according to the theory which he is using, or appear to take any interest in the remarkable fact that the observed motions of bodies define such a base, which presumably has some relation to other physical phenomena. The only occasion on which he attempts to deal with the foundations of the subject is in connection with the law of action and reaction in statics, the treatment of which is clumsy and unconvincing, perhaps even unintelligible.

As in the case of the rest of physics, there are two ways of looking at mechanics, each of which has its own proper place. One is to regard all parts of the subject as coordinated by means of a generalisation which is as comprehensive as possible. The other is to aim rather at isolating the points involved in the subject, so that any degree of independence which they possess may be recognised, and so that it may as much as possible be seen how far the most precisely ascertained results carry us, and whether a doubt cast on any particular doctrine affects the whole foundation of the subject or not. Though the attainment of the former is the constant aim of scientific study, the latter is the proper attitude in which to approach it, and it seems to be a mistake to write the first chapter of physics in a different spirit. W. H. M.

CANNIZZARO'S COURSE OF CHEMICAL PHILOSOPHY.

Sketch of a Course of Chemical Philosophy. By Stanislao Cannizzaro (1858). Alembic Club reprints, No. 18. Pp. iv+55. (Edinburgh: The Alembic Club, 1910.)

THE Alembic Club have done well at this juncture to publish a translation of Cannizzaro's famous letter to De Luca—a letter which, to use Davy's phrase in connection with an equally memorable pronouncement, acted like an alarm-bell on Europe. Indeed, now that he has joined the majority, no more fitting monument to the perspicacity and genius of the great Italian chemist could be conceived than the publication, in the form of an admirably executed translation, of that statement of doctrine which astonished and ultimately convinced the chemical world of the mid-Victorian epoch.

To the chemists of the present age it is hardly possible to convey an idea of the profound sensation which this letter created. The effect was immediate and irresistible. At that time the name of Cannizzaro was hardly known beyond a limited circle of French and Italian men of science. With the appearance of the message came the conviction that a Daniel had come to judgment—that a prophet and a law-giver had arisen amongst us. The middle period of the last century was a time of political ferment and social unrest, and here and there it culminated in revolution. It was equally a period of disturbance and upset in other spheres of human activity than politics and sociology. In chemistry, more perhaps than in the case of any other science at that time, the old order was changing, but the process was destructive rather than constructive. Old faiths were being undermined and thrown down, but the new dogmas had not stability enough to supplant them.

Cannizzaro's letter appeared at what, in the cant-phrase, is termed the psychological moment. It brought order, method, and arrangement into what hitherto had been a mass of inconsistency and contradiction. Its logic was so clear, its appeal to history and to well-ascertained fact so irrefutable, its statement of proof so admirably marshalled, that criticism was silenced, and the doubter disarmed. Before a decade had passed its principles were everywhere accepted, and it is not too much to say that Cannizzaro effected a revolution in chemical thought as momentous in its way as the revolution he was subsequently concerned in bringing about in the political development of Italy.

To the student of chemistry it would be superfluous to enter into an analysis of Cannizzaro's letter, as its principles are now intimately woven into the web of modern chemical doctrine. Indeed, so indissolubly associated is the fundamental basis of Cannizzaro's chemical philosophy with the chemical philosophy of to-day that the statement of these principles, or of the course of argument upon which they are based, would have the semblance of a platitude. But we can assure the student that, however familiar he may be with the outcome of the doctrine with which the name of Cannizzaro will be imperishably connected, he will read with admiration and delight the *pronunciamento* in which the Genoese chemist makes known to his friend and colleague, and through him to the world, the dogma of what was henceforth to be the new chemistry—with admiration for the extraordinary perspicacity and conviction of its argument, and with delight at the simplicity and force of its statement.

T.

PRUNING OF FRUIT TREES.

Fruit Tree Pruning. A Practical Text-book for Fruit-growers working under the Climatic and Economic Conditions prevailing in Temperate Australia. By George Quinn. Pp. vi+230. (Adelaide, Australia: R. E. E. Rogers, Acting Government Printer, 1910.) Price 1*s.* 3*d.*

THE pruning of fruit trees is an operation that demands, on the part of the operator, first, an intimate knowledge of the natural habits of the particular trees, and, in the second place, considerable experience of the general results which follow a proper system of pruning. Unfortunately, every gardener and amateur who cultivates ever so few trees gets the conviction that, come what will, he must prune, and, if he is ignorant of the methods, nevertheless he mutilates the branches and imagines that his trees will respond satisfactorily to the treatment given

them. In these circumstances it is not to be wondered at if the value of pruning in any form or degree has come to be questioned by certain fruit-growers and experimentalists, who have had very little diffi-better to expose all parts of the tree to the sun and of diminishing the crop.

It still remains incontrovertible, however, that young trees are benefited by a moderate degree of pruning if this is carried out by intelligent operators possessing the knowledge and experience necessary for the task. Such pruning is necessary for forming a proper foundation for the tree, for the removal of cross-branches, and the thinning out of the centre in order to better expose all parts of the tree to the sun and air.

This volume, prepared by the horticultural instructor for the Department of Agriculture, South Australia, under the direction of the Hon. Minister of Agriculture, is issued for the purpose of teaching the technique of pruning to fruit-growers having to work under the climatic and economic conditions prevailing in temperate Australia. The author's qualifications for teaching are clearly shown in his sensible and pertinent remarks upon the facts on which the theory of pruning is based, and his description of the objects the pruner seeks to obtain. Having instructed the reader in these matters, he describes the opposite effects of winter and summer pruning, the parts of a tree, and their different values; also the forms of tree to be encouraged, and the best means of developing fruit-bearing wood in place of foliaceous but barren branches. He next passes to a description of the specific treatment of different kinds of fruit, including apricot, plum, cherry, almond, peach, apple, pear, quince, fig, orange, lemon, and loquat.

There are 200 illustrations from photographs, most of these being valuable as a means of explaining the text, but others are inferior, and their omission would not have detracted from the appearance of the volume.

UNCONSCIOUS MEMORY.

Unconscious Memory. By Samuel Butler. New edition. With an Introduction by Prof. Marcus Hartog. Pp. xxxvii+186. (London: A. C. Fifield, Clifford's Inn, E.C., 1910.) Price 5*s*. net.

It is probable that Butler will live in history as the writer of "Erewhon," but his more serious works, dealing with what may be called the philosophical side of biology, are still worth reading, and Mr. Fifield's re-issue will be welcomed by many. The volume under review consists partly of rather personal polemic against Darwin, and partly of a further development of Butler's views as expressed in his "Life and Habit." These views may be summarised as follows.

It is a fact of hourly observation that practice makes things easy which once were difficult (*e.g.*, the playing of a sonata), and even results in their being done without consciousness of effort. It follows that the fact of an intricate action being done unconsciously is an argument for the supposition that it must have been done repeatedly already. Now take the case of a newly-hatched chicken, which pecks at once and perfectly. How is this? It is because something in the chicken remembers having pecked before, and consequently knows how to do it. An individual is not a new being; it—or part of it—has existed in the bodies of its parents. Thus heredity is memory. Cells remember what they have done before, and know how to do it again.

This, followed to its conclusion, involves the attribution of some kind of intelligence even to atoms. Indeed, we can hardly avoid it. Atoms have their likes and dislikes. Carbon and oxygen are sociable, fluorine is reserved and stand-offish. "The distinction between inorganic and organic is arbitrary." (This view is closely akin to that of Haeckel.) All action is purposive and intelligent. When an organism develops a new quality, it is because the organism has felt the need of it. Evolution is therefore teleological from within; differentiation of species, and variations of all kinds, are not entirely due (or as much as Charles Darwin supposed) to natural selection. Here Butler follows Buffon, Lamarck, and Erasmus Darwin.

Mr. G. Bernard Shaw has said that Butler was, in his department, the greatest English writer of the latter half of the nineteenth century; and, though he was only a *dilettante,* it is surprising how illuminating and suggestive his ideas seem, even now, thirty or forty years after first publication. It is noteworthy that Dr. Francis Darwin quoted him with special approbation in his presidential address before the British Association in 1908.

Prof. Marcus Hartog furnishes a useful introduction, discussing Butler's whole work and his place in the history of science.

The first edition of "Unconscious Memory" was reviewed in Nature, January 27, 1881.

THE MAMMALS OF EUROPE.

Faune des Mammifères d'Europe. By Prof E.-L. Trouessart. Pp. xvii+266. (Berlin: R. Friedländer and Sohn, 1910.) Price 12 marks.

In issuing an up-to-date descriptive catalogue of the mammals of Europe Prof. Trouessart has conferred a real and lasting benefit on zoological science, since, owing to the great increase of species and races due to modern methods of discrimination, the well-known work of Blasius has long been practically useless. Indeed, if the two works be compared, it might at first sight be difficult to believe that they treat of the same subject, so great has been the increase in the last few years in the number of recognisably distinct forms, and so extensive the changes in nomenclature. Nowadays views differ—and will probably continue to differ—as to the limitations of species and races; but Dr. Trouessart appears inclined in most cases to use the former term in the most restricted sense. Justifying himself in doubtful instances by the dictum of Desmarest that "il est plus misable de trop réunir que de trop diviser," he might, if we remember rightly, have supported an opposite view by a statement of Huxley to the effect that it is more important to re-

cognise resemblances than to overlook differences; and in the excessive multiplication of genera and species (as distinct from division into races) there is undoubtedly a great danger of losing sight of mutual affinities.

As instances of this multiplication, reference may be made to the specific separation of the Irish from the Scotch hare, of the Scotch from the English wild cat, and of the British from the Continental water-rats. On the other hand, the British squirrel is regarded merely as a local race of the Continental species, a classification difficult to reconcile with that adopted in the case of the species just mentioned. Whatever may be individual views on such matters, we venture to think that most naturalists will agree in objecting to the principle of introducing the names of one or more species between those of the typical form and the races of another, as is done in the case of the wild cats. In regard to generic grouping, it may be mentioned that, in the case of mice, the long-tailed species appears as *Mus sylvaticus*, and the harvest-mouse as *Apodemus minutus*, whereas the latter (if generic splitting be adopted), should be *Micromys minutus*, and the former *Apodemus sylvaticus*. The weasels, again, are included in the same genus as the polecats, from which they are sundered by many modern naturalists. As regards the distribution of the European fauna, the author recognises four distinct areas, viz., Central European, Arctic, Eastern or Steppe, and African or Mediterranean.

While congratulating Dr. Trouessart on the completion of a laborious task, we may take the opportunity of mentioning that his work strongly emphasises and confirms a reply the present writer was compelled to make some months ago to Dr. A. R. Wallace, namely, that to give, even approximately, the number of species of mammals inhabiting the various zoological provinces is, under present conditions, an absolute impossibility. It is very largely a case of "go as you please." R. L.

THE SCIENCE OF PATHOLOGY.

The Principles of Pathology. By Prof. J. G. Adami, F.R.S., and Prof. A. G. Nicholls, F.R.S. (Can.). Vol. II., Systemic Pathology. Pp. xvi+1082. London: Henry Frowde and Hodder and Stoughton, 1910.) Price 30s. net.

THIS second volume of Prof. Adami's great work on the science of pathology deals with systemic pathology—the pathology of the individual tissues and organs of the body, or special pathology, as it is often termed—and has been written in conjunction with his colleague, Prof. Nicholls. In the preface the authors offer an (unneeded) apology for the bulkiness of the first volume on general pathology (reviewed in NATURE of November 25, 1909, vol. lxxxii., p. 94), and the relative brevity of this second volume, for many would consider that special pathology requires at least double the space devoted to general pathology. They point out, however, that, provided the student has acquired a good grasp of general pathology, he has but to apply those principles in order to become possessed of a sound basis of special pathology, a proposition with which we are in complete agreement.

But for the inclusion, therefore, of the pathology of the blood and cardio-vascular system, and also of the disorders of function as well as of structure of the various organs, even the present volume might have been curtailed in length. At the same time, we think that this attempt at brevity has in some cases been carried too far, and although the subjects may have been dealt with at length in the first volume on general pathology, some repetition would not have been out of place. As instances, we may mention the bare reference to diabetes in the section dealing with the pancreas, and the omission of blackwater fever as a disease in which hæmoglobinuria occurs. Otherwise, we confess we have found little to criticise, and the work gives a very full and accurate account of the subject.

Each organ is dealt with on a systematic plan; first a brief summary of its developmental history, anatomical structure and physiological functions, followed by a description of the congenital and acquired abnormalities, circulatory disturbances, inflammations and parasitic infections, and retrogressive and progressive metamorphoses to which it may be subject. In the division devoted to the blood and cardio-vascular system, the sections dealing with leukæmia seem somewhat brief in view of the importance of the subject, and no mention is made of cases of the lymphatic variety in which the total number of leucocytes is not markedly increased, but in which nearly all the leucocytes present are lymphocytes. In the section dealing with pernicious anæmia also no mention is made of the almost invariable leucopenia present, a point of considerable diagnostic importance in the numerous cases in which the blood picture is not typical. In discussing the origin of œdema, the authors hold that the facts demand the assumption (with Heidenhain) that the lymphatic and capillary endothelium is endowed with a certain grade of selective secretory activity.

In the section dealing with the diseases of the nose it is surely not expedient to refer to the common polypus as a "polyp," a term which now has a more or less definite zoological signification.

We congratulate the authors heartily on the completion of their labours; the work is not a mere compilation, but is the outcome of a ripe personal knowledge of the subject. Divergent views are stated fairly, and if the authors' views do not always agree with those current, the reasons are given, and they merit careful consideration.

The book is profusely illustrated with plates and figures (some coloured), drawn or photographed directly from patients, specimens, and sections, which are admirably reproduced. We think it a mistake, however, not to have given the magnification of the photomicrographs; simply to state, as is done, the lenses with which the photographs were taken does not sufficiently indicate the magnification of the object depicted.

OUR BOOK SHELF.

Household Foes. A Book for Boys and Girls. By Alice Ravenhill. Pp. xxiii+359. (London: Sidgwick and Jackson, Ltd., 1910.) Price 2s. 6d.

MISS RAVENHILL has written this small work with the object of arousing the interests of boys and girls in the practice of daily domestic cleanliness, and at the same time of furnishing them with reasons for this practice. She also aims at indicating the links which should be made to connect school lessons with home habits, and prominence is given to the value of good habits and to the necessity for their constant daily practice. She directs attention to the broad educational value of the subject of "hygiene," in exercising observation and reason, and in cultivating the habit of tracing effects to their causes. The text of most of the chapters is "dirt"—the dirt of home surroundings, of air, water, and food; and at the end of each chapter references are given to works in which the subject-matter may be further studied and developed, more especially on the practical and experimental side. Young people are slow to learn that there are no rights apart from responsibilities, which in this connection include duties to self, to home, to community, to empire, and to race; it is well, therefore, that Miss Ravenhill devotes her two concluding chapters to "the citizen's power to control dirt, decay, and disease," and "imperial safeguards against dirt and disease."

Hygiene has gradually found a footing in the elementary school code; but one cannot hope, for some years to come, to get the best results of this teaching and training, for the reason that school teachers as a body do not possess the necessary knowledge to enable them to present the subject with judgment and discrimination. This small work well serves as a very useful guide to them, and to this end it is perhaps the best statement hitherto published, for the essential facts are dealt with in an appropriate and impressive manner, and the book contains little (if anything) which is unsuitable or unnecessary, while the authoress tells practically all that it is necessary to tell. A child with the elementary knowledge of hygiene which Miss Ravenhill seeks to convey, and trained to act in accordance with its precepts, should be well equipped from the standpoint of hygiene. The book may be confidently recommended to all those parents and teachers who are concerned with the education of the young.

History of Chemistry. By Sir Edward Thorpe, C.B., F.R.S. Vol. i., From the Earliest Times to the Middle of the Nineteenth Century. Pp. viii+148. Vol. ii., From 1850 to 1910. Pp. viii+152. (Issued for the Rationalist Press Association, Ltd.) (London: Watts and Co., 1909 and 1910.) Price 1s. net each volume.

SIR EDWARD THORPE, who has enriched chemical literature with so many valuable biographical contributions, has added greatly to our indebtedness by the publication of these two small volumes of chemical history. In method and style they follow the eminently readable work of Thomas Thomson, which has been so long out of print, and in many respects out of date, and the modern student is now supplied with a brief history of chemistry, which is well within his intellectual and material means, and cannot fail to add greatly to the interest of his studies. The divorce of historical and other human interest from the study of science, resulting from our examination system, is greatly to be deplored. It gives good ground for the allegations of aridity so often made against scientific teaching and scientific text-books, and it deprives the student of much that would aid him in the comprehension of modern chemical theory. It is to be hoped that these volumes will have a very wide circulation, and that students may be encouraged to proceed to study some of the works which are indicated in the appended bibliographies.

The first volume, beginning with the chemistry of the ancients, brings the reader to the early part of the nineteenth century, whilst the second volume follows the subject to the present day. This last volume is naturally highly compressed, but, like the first, it bears the imprint of a master-hand in the exact and readable presentation of chemical history. A series of admirable portraits is inserted throughout the work. A. S.

A Course of Elementary Science, Practical and Descriptive. By John Thornton. Pp. vi+216. (London: Longmans and Co., 1910.) Price 2s.

THIS book, which contains chapters on measurement, mechanics, and heat, is intended by the author for junior pupils who are attending class and laboratory instruction. As the title implies, it is partly descriptive and partly practical in character. After perusing the book one is led to the conclusion that the author has not a very wide acquaintance with physics or much experience of up-to-date laboratory methods. The book has the characteristic of those many manuals on this subject which appeared so hurriedly ten or twelve years ago. The language is often loose, *e.g.* p. 13, Expt. 1, "Draw a large circle on a sheet of cardboard and divide it into degrees." On p. 29 the author states that results need not be carried beyond the second decimal place as a rule. In determining quantities in the laboratory where the final result is obtained by arithmetical operations on quantities actually measured, it is the degree of accuracy with which these several quantities are measured that determines the number of significant figures in the final answer. Such examples as Expt. 11, p. 35:—Weight of lead in air, 17 oz.; weight of lead in water, $15\frac{1}{2}$ oz.; specific gravity, 11·3; or the example on p. 41:—3000/0·85=3529·4 c.c., are ill-chosen. On p. 131 we are told that the steel rails of a tram line have a small space left between their ends, when laid, to allow for expansion. How many observant boys have looked for such spaces and failed to find them? On p. 144 it is stated that water expands regularly from ordinary air temperature to 100° C.

The Brooks Patent T-square Lock. (Letchworth, Herts: Wm. J. Brooks and Co.) Prices 4s. 6d. and 5s. 6d.

THIS very useful adjunct to the ordinary T-square is one of the best of the devices which have recently been introduced to facilitate the work of the draughtsman, and it will be much appreciated by all who are engaged in mechanical and architectural drawing. The contrivance is simple in character, moderate in price, and well made, and is designed so as to be readily attachable to any existing square, no alteration of the drawing board being required. By its use the T-square, without loss of freedom, is instantly locked in any desired position on the board, thus freeing both the hands of the operator. The lock may be put out of action at will, and the T-square manipulated in the ordinary manner. The "lock" attachment will be found extremely serviceable when used with a board which rests horizontally, as on a table, but when the board is much inclined or is vertical, the employment of this or a similar device is indispensable. There are many teachers who might with great advantage utilise this apparatus for black board work.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Helium and Geological Time.

IN NATURE of October 27 (p. 543) a short notice appears relative to some experiments of Prof. A. Piutti, of Naples, on the occlusion of helium from the air by salts in the act of solidification. Prof. Piutti apparently considers his results as throwing doubt on the figures which I have given for the age of different geological formations from the accumulation of helium in them. I wish to give my reasons for dissenting from this criticism.

In the first place, it is not clear from Prof. Piutti's description that the gases extracted from his solidified salts contain any more helium than normal atmospheric air. He has not attempted to show, if I understand his description rightly, that there is any *selective* absorption of helium in preference to the other atmospheric gases; nor is it at all likely that such a selective absorption exists, for we have no knowledge of chemical affinity between helium and other gases, while, in respect of solubility, it would probably be inferior to them. Again, on account of its low molecular weight, it would, if anything, be better able to escape from mechanical retention. But the gases from minerals are in practically all cases many times richer in helium than is atmospheric air. Mere retention of air cannot therefore account for any appreciable proportion of the helium found.

There remains the question, also alluded to by Prof. Piutti, of whether helium can have been absorbed from any source in the interior of the earth. I have already discussed this question, as regards igneous rocks, in Proc. Roy. Soc., A, vol. lxxxiii., p. 298. As regards the bulk of the rock, it is impossible to exclude such an origin, and I have carefully avoided drawing conclusions which might be vitiated by it. My inferences have been drawn from minerals like zircon and sphene, which are immensely more radio-active than the rock in general, and immensely richer in helium. It is without plausibility to assume that the excess of helium in these has any extraneous origin.

R. J. STRUTT.

Imperial College of Science, South Kensington.

Pwdre Ser.

ON my return from a field season beyond the reach of periodicals, I have just seen, for the first time, Prof. McKenny Hughes's article on "Pwdre Ser" in NATURE of June 23, and the correspondence relating thereto in the succeeding numbers. It may interest your readers to know that a substance of this sort was found by Mr. Rufus Graves (at one time lecturer on chemistry in Dartmouth College) at Amherst, Mass., on August 14, 1819, and by him identified with a luminous meteor which had been seen to fall at that spot on the previous evening. His report of the occurrence appeared in the *American Journal of Science*, vol. ii., pp. 335–7, 1820. The mass of jelly was circular, about 8 inches in diameter and about 1 inch thick. It was of a bright buff colour, and covered with a "fine nap similar to that on milled cloth." The interior was soft, of an insufferable odour, and liquefied on exposure to the air. Some of this liquid was allowed to stand in an open glass for a few days, when it had entirely evaporated, leaving only a small quantity of a "fine ash-coloured powder without taste or smell," which effervesced strongly with sulphuric acid, but not with nitric nor hydrochloric.

Mr. Graves's account was noted by Arago in the *Annal. de Chimie*, vol. xix., pp. 67–9 (1821), who quoted also several similar occurrences cited in earlier chronicles. It is probable, of course, that Mr. Graves was mistaken in his identification, that the meteor actually fell at some other point, and that the jelly was confused therewith only because no other unusual substance was found at the point where the meteor was *supposed* to have fallen. Mr. Graves himself considered that there was "no reasonable doubt that the substance found was the residuum of the meteoric body," but the evidence which he states is hardly satisfactory to the modern, more critical inquirer.

It seems probable that these jellies are, in general, plasmodia of some form or forms of Myxomycetes, and that their common identification with falling stars may have its basis in the frequent recurrence of this error into which Mr. Graves seems to have been led. It is well known that visual estimates of the distance of falling stars are almost invariably far too low. If, then, an untrained observer of a meteor goes next morning to the near-by place where he *thought* he saw the body fall, and finds there no unusual body excepting one of these plasmodia, the jelly and the meteor are almost sure to be associated in his mind. Especially is this probable, since the plasmodia, in general (at least in my experience), have the appearance of having fallen on the grass rather than of having grown there.

EDWARD E. FREE.

United States Department of Agriculture, Bureau of Soils, Washington, D.C., October 17.

On Hydrogen in Iron.

AT the recent meeting of the British Association at Sheffield, Sir Norman Lockyer referred to the relationship between hydrogen and iron at stellar temperatures. Some observations of mine, made several years ago, are of interest in this connection. I also note that at the recent meeting of the Iron and Steel Institute, in a discussion on the influence of carbon in iron, it was suggested that the gases known to be present should also receive attention.

Iron contains ten times its volume of hydrogen, and in many instances 20 volumes of hydrogen; even 100 has been noted. Iron therefore contains from about 0·013 to 0·026 per cent. of hydrogen, 100 volumes equalling 0·13 per cent., all deemed important in metal with like proportions of carbon and sulphur and phosphorus. It is now fully admitted that hydrogen hardens iron, and should therefore be estimated: 1 gram frozen H, *ice* = 7·2 c.c., 0·1 = 0·72 c.c. I note also iron = 1 c.c. = 7·2 gram iron. 1111 c.c. of solid H = 1/10 gram in 100 iron = 14·4 c.c. = 7 grams per 1000 c.c., and 1000 ordinary pressure = only 0·08961 gram. The figures quoted are apparently in accordance with the periodic law, series 1–7.

As regards the above, more might be said if space permitted.

JOHN PARRY.

October 19.

Research Defence Society.

IN connection with the cases of plague in Suffolk, let me say that this society has lately published an illustrated pamphlet on "Plague in India, Past and Present," by Lieut.-Colonel Bannerman, director of the Bombay Bacteriological Laboratory. It gives a full account of the experiments which proved that fleas carry the plague from rats to man; it also gives a full account of Haffkine's preventive treatment, and of the many thousands of lives which have been saved by this treatment. I am sorry that the Research Defence Society cannot afford to give away this pamphlet in large quantities, but I shall be happy to send it to any of your readers who will send me seven stamps. I shall also be happy to send copies, on sale or return, to all booksellers.

STEPHEN PAGET.

(Hon. Secretary Research Defence Society.)

21 Ladbroke Square, London, W.

British Mammals.

I AM grateful for your reviewer's good wishes for the success of my book (NATURE, October 20). He writes that he has only one fault to find, namely, that a paper of Dr. K. Andersen's dealing with the authority for the names *Nyctalus noctula* and *N. leisleri* is not mentioned anywhere. I beg to state that the title of this paper is given on p. 53. It could not be cited in the synonymy, as the names *Nyctalus noctula* and *N. leisleri* do not actually occur in it. In fact, I believe that my book is the first in which these names occur.

G. E. H. BARRETT-HAMILTON.

THE OCEANOGRAPHICAL MUSEUM AT MONACO.

IN the history of the development of the study of the sea all the sciences find an application, and all were worthily represented at the inauguration of the Oceanographical Museum of Monaco on March 29 of this year. The ceremonies and festivities incident to the occasion have already been chronicled in the columns of NATURE (April 14, vol. lxxxiii., p. 191). It is proposed here to give an impression of the life-work of the Prince of Monaco, which found expression in the solemnities of that occasion. The accompanying illustrations[1] afford an idea of the magnificence of the building and of the richness of the collections. Fig. 1 gives a view of the museum from the sea. The scale on which it is built can be judged from the fact that the height of the roof above the lowest masonry is 75 metres. Fig. 2 is the statue of the Prince standing on the bridge of his yacht. It is an artistic work, and a good portrait. It gives fine expression to the modesty as well as to the power of the creator of the great monument in the centre of which it stands.

The museum and the vessels attached to it, with their staffs and general organisation, are only one-half of the great enterprise which is entitled, "Institut Oceanographique Fondation Albert Ier Prince de Monaco." Its seat is in Paris, where it possesses its own buildings and a rich endowment, both of them the gift of the Prince. It has professors of physical and biological oceanography and of the physiology of marine animals, and the lectures delivered during last year had the most numerous attendance of any in Paris. During the life of the Prince he exercises supreme authority. Both in Paris and at Monaco there is complete organisation for giving effect to his wishes, and, in the event of his death, for carrying on the work without interruption, and on the lines inaugurated by himself. Thus continuity and permanence have been assured.

It will be readily realised that the establishment of these two great institutions has not been accomplished without the expenditure of large sums of money and the devotion of much time and labour to it. It is almost impossible for anyone to realise the greatness of the work which is being accomplished without having been intimately connected with it, and even with this advantage the development of the conception is slow. As with all great achievements, it will take at least a generation before it is thoroughly understood and adequately appreciated.

The museum at Monaco bears testimony at every turn to the great lines on which the Prince has himself worked, and in which his work is fundamental. Thus, in the purely hydrographical department, we see his bathymetrical chart of the world, on which all the trustworthy deep soundings are entered. This great document may be said to be the foundation-stone of oceanographical work. Another and much earlier piece of hydrographical work is the current chart of the North Atlantic, which gives the result of his laborious work on board the *Hirondelle*. By the methodical dispersion of floats, especially constructed to expose the least possible surface above water, along different lines radiating generally from the group of the Azores, by patiently awaiting their recovery, and by then combining their records, he furnished the demonstration that this portion of the ocean is practically a lake, bounded, not by land, but by the motion of its own peripheral waters, thus enclosing a roughly circular portion of the sea, part of which is generally associated with the Sargassum weed and called the Sargasso Sea. The water, thus self-confined in the warm, dry subtropical region, is exposed to powerful evaporation, and to a considerable annual variation of temperature at the surface. The combination of these two thermal factors furnishes the mechanical power by which the deeper layers of the water obtain more heat and attain a greater density in this sea than they do in any other part of the open ocean, as was pointed out by the writer in a paper "on the vertical distribution of temperature in the ocean," read before the Royal Society on December 17, 1874, and published in its Proceedings, vol. xxiii., p. 123.

FIG. 1.—General view of the Oceanographical Musenm at Monaco as seen from the sea.

In the great hall to the left of the entrance the visitor is at once struck by the magnificent collection of skeletons of Cetaceans, which includes those of many species. These are skeletons of individual whales, nearly all of which have been killed by the Prince himself, and each is complete, every bone in the animal being accounted for. From all points of view this collection is at once the most attractive and the most interesting in the museum, and in it we see the Prince reflected as a hunter and as a naturalist.

In Fig. 3 we have the Orca, with its formidable double row of teeth. It preys on other Cetaceans, and always shows plenty of sport. The specimen figured belonged to the leader of a school of three, which was

[1] For the illustrations in this article we are indebted to the courtesy of the proprietor of the *Naturwissenschaftliche Wochenschrift*. They are reproduced from photographs by Prof. Doflein, of Munich, and illustrate an article by him in that periodical.—Editor, NATURE.

met with a few miles outside of Monaco. They fought to the death, and when killed they were towed in and beached on what is now the new harbour of Monaco.

FIG. 2.—Statue of Prince Albert I. of Monaco in the Museum

Not far from the Orca is a skeleton, Fig. 4, of the best known of the toothed Cetaceans, the cachalot or sperm-whale. It was not taken by the Prince himself, but he was present at its capture, and his scientific instinct enabled him to seize an opportunity which would probably have been missed by another. The cachalot had been struck by a crew of whalers from Terceira, one of the islands of the Azores. The Prince followed the chase in his yacht, and was close to the animal when it became evident that its end had come. At this moment these animals always charge whatever they see, and in their death agony they usually render whatever they have last eaten. This animal charged the *Princesse Alice*, but the charge did not get home. The animal stopped, and a large mass of something came out of its mouth close to the yacht and began slowly to sink. The Prince at once jumped into the dinghey, and, with a long landing net, retrieved the object before it sank out of sight. The object is represented in Fig. 5, and is a unique piece. It is a fragment of the gigantic scaled cephalopod which Prof. Joubin, who described it, named *Lepidoteuthis Grimaldii*.

A healthy cachalot is valued for the spermaceti, or wax, which is contained in its head, and a sick one is still more valued for the ambergris which it may contain. This curious substance, which has at all times been so highly esteemed in pharmacy and perfumery, forms the subject of a very interesting "Account of Ambergris" by Dr. Schweidawer, which was read before the Royal Society on February 13, 1783, and published in the Philosophical Transactions, vol. lxxiii., p. 220. From his investigations it appears that ambergris is a by-product of an inflammation of the intestine, which has probably been started by the "beaks" of the cephalopods which it has swallowed, for these are the invariable and characteristic ingredient of all genuine ambergris. He further states that the whalers are convinced that the cachalot feeds only on squids, which, when unmutilated, must be of great size. One whaler reported a case where the whale in its death-throe rendered a single tentacle, which, though incomplete from having been partially digested, still measured 29 feet in length, and he held that this justifies the common saying of the whalers that the squids are the biggest fish in the sea.

The work of the Prince amongst the toothed Cetaceans has had an interesting sentimental result. The combat of the "thrasher" and the whale, so dear to the nautical mind, seems to be

FIG. 3.—Skeleton of the great Orca killed by the Prince of Monaco near Monaco.

nothing but the violent and desperate resistance of the giant squid to being swallowed when brought to the surface by the cachalot.

The whalebone whale, shown in Fig. 6, was struck by the Prince in May, 1896, not many miles from Monaco, but it escaped. Its carcase was washed ashore in September of the same year, near Pietra Ligure, on the Italian Riviera. A remarkable feature of this skeleton is the evidence of fracture and repair of a number of ribs of its left side. This has been ascribed to collision with a steamer, but it is very unlikely that such an experience would leave its mark in nothing but a number of perfectly repaired ribs. It would seem to point to a type of accident to which whales are certainly exposed, and from which they perhaps not infrequently suffer.

FIG. 4.—Skeleton of the Cachalot which furnished the fragments of gigantic Cephalopods

The habitat of the whale is the air and the water, and its functional economy has to be adapted to life in both elements, or rather, to life sometimes in the one, at other times in the other element.

In one of the Prince's recent cruises in the Mediterranean the yacht was found to be steaming in the wake of a whale, which was evidently making a passage, and in a leisurely way. The Prince seized the opportunity to follow the animal without pursuing it, and this was done with such skill that it remained unconscious of being followed. It kept a steady course, and, to "keep station" with it, the *Princesse Alice* had to steam at a speed of about ten knots. In these conditions the whale came up to breathe at regular intervals of between ten and eleven minutes, the intervals between the spouts being the same almost to a second. This experiment supplies an important constant in the natural history of the whale. It looks very simple, but it will not be readily repeated, except perhaps by the Prince himself. As the whale was on passage, it is unlikely that it went far below the surface, but there is abundant evidence that, in the search for food or to escape enemies, it penetrates to very considerable depths. In these excursions its body is exposed to rapid and considerable variations of pressure. These have to be borne by the structural frame of the animal, of which the ribs are an important part.

It is generally assumed that, before sounding, the whale fills its lungs with air, but this, being at atmospheric pressure, is of no use in assisting the body to resist the external pressure of a column of water equivalent, it may be, to many atmospheres. How the power of resistance is, in fact, provided, I am not anatomist enough to know, but it must be finite, and it is easy to imagine conditions in which the animal, whether in the pursuit of prey or in the endeavour to escape being made itself a prey, may strain it beyond its limits, and the ribs of one side, whichever is the weaker, may give way. In such an accident, beyond being broken, the ribs need not be seriously disturbed, and with the return to the surface or more moderate depths, they would fall into their places again, and that all the more easily because there is little or no pressure of one part on another, every part of the body of a totally immersed animal being

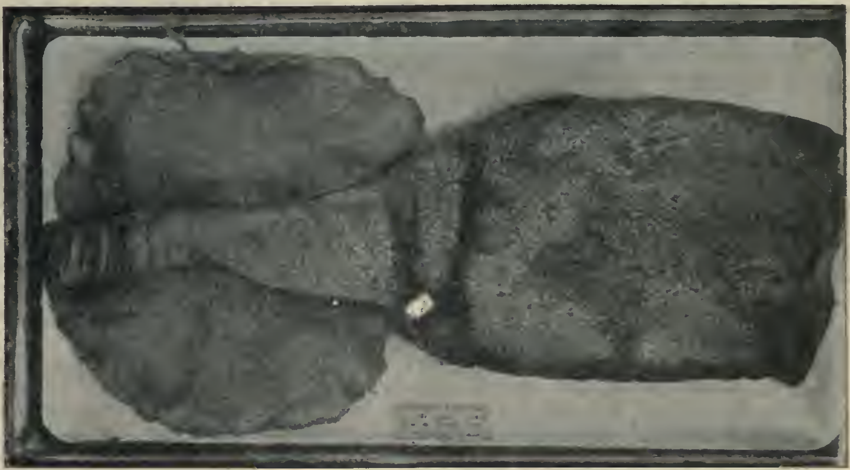


FIG. 5.—The principal ragments of *Lepidoteuthis Grimaldii*, Joubi

water-borne. In such conditions recovery would be rapid and the joints perfect, as can be seen to be the case in the skeleton in the museum.

The accident to this whale is very suggestive. In a well-known experiment, Paul Bert reduced the pressure of the air in the lungs of a dog by a not very large fraction of an atmosphere, when the thorax immediately collapsed, every rib being broken. When a whale is struck and sounds, if only to a depth of one hundred metres, the pressure on its body is increased tenfold in a few seconds. How does its body stand it?

It is certain that the cachalot finds its prey in water of considerable depth. When it has seized it, can it swallow it *in situ*, in a medium of water under very high pressure? The dentition of this animal, a formidable row of teeth in the lower jaw fitting into corresponding sockets in the upper jaw, makes it certain that, when it has seized its prey it can hold it indefinitely. It has been observed that the cachalot sometimes takes its prey to the surface and swallows it there. Is this accidental or habitual? If habitual is it not another link with the far-back time when its habitat was the air and the land? These are some questions suggested by an attentive visit to the Museum of Monaco.

In the museum, room is provided for a department of meteorology, a science which, especially as regards its application to the higher regions of the atmosphere, owes much to the participation of the Prince in its development. Until he directed his attention to it, the *ballons-sonde*, carrying their freight of valuable instruments, were very frequently lost. Now, thanks to the method of keeping the "dead reckoning" of the balloon, developed and brought to perfection on the *Princesse Alice*, if it is followed for a few minutes during its ascent, it may disappear in the clouds, and its recovery, when it descends at sea, is almost a certainty. This department of investigation has been prosecuted outside the Mediterranean, and in the Prince's cruises of the last two or three years it has been carried from the Cape Verde Islands in the heart of the tropics to the north of Spitsbergen, within five hundred miles of the Pole.

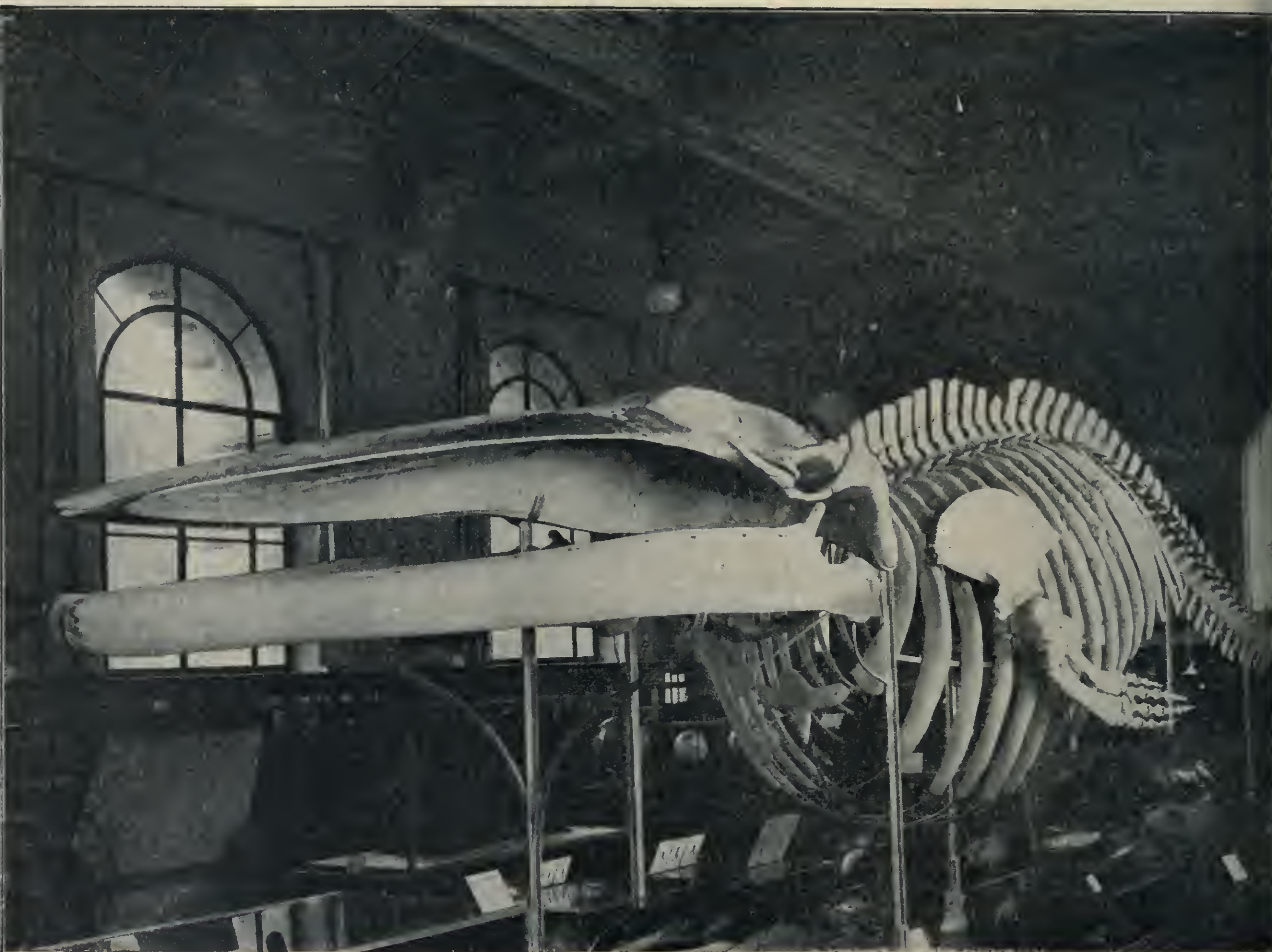


FIG. 6.—Skeleton of whalebone whale the ribs of which have been broken and mended.

Besides the collections of animals and the instruments for their capture and study, there is in the lower part of the museum an aquarium, remarkable for its size and the completeness of its installation. This already commands a constant flux of visitors, chiefly the curious, but it is also frequented by men of science for serious study. It is already proposed to enlarge it considerably. The storey above the aquarium is divided into separate laboratories, fitted

with a service of both fresh and sea water, and everything else required for chemical, physical, and biological study. In these laboratories the occupant has all that a laboratory can supply, and at any time fresh material from the sea, collected by one of the small steam tenders of the museum.

Any notice of the museum of Monaco would be incomplete without an acknowledgment of what it owes to its director, Dr. Richard. None of the many men of science who have enjoyed the hospitality, either of the museum or the yacht, will require to be reminded of this, nor will they forget what they individually owe to Dr. Richard's never-failing courtesy and helpful aid. Personally, I have more thanks to offer than I can express for the countless services that he has rendered me during our friendship of twenty years. The Prince was fortunate in being able to attach him to his service in the early days of the *Hirondelle*. Since that time Dr. Richard has been his never-failing aid and assistant. It is not too much to say that without Dr. Richard's strenuous and unselfish work during these many years the museum with its rich collections and complete equipment would not be, as it is now, the greatest institution of the kind in the world.

J. Y. BUCHANAN.

ENVIRONMENT VERSUS HEREDITY.[1]

THE question of the assimilation of immigrants under American conditions has long been looked upon as of vital importance, and it has been much discussed, but heretofore with little accurate information. Speaking from general personal observation, people have thought that under the influence of the existing educational, social, and political conditions the immigrants gradually change their habits of life and their ways of thinking, and thus become Americans. The statement is often made that American citizens tend to resemble the American Indian, meaning thereby some generalised type of plains Indian, but this has never been put to scientific test. Little or no thought, however, has been given to the possible effect of the physical and social environment on the physical type of descendants of immigrants. The establishment by Congress of the Immigration Commission in February, 1907, gave the opportunity for a thorough investigation of the problems of immigration, and the inquiry into the anatomical characters of immigrants and their descendants was put under the direction of Prof. Franz Boas, of Columbia University, than whom no better selection could have been made. The present short report deals with only a portion of the material collected, but results obtained are of unexpected interest and importance.

The results so far worked out may be summarised as follows:—

1. The head form, which has always been considered as one of the most stable and permanent characteristics of human races, undergoes far-reaching changes due to the transfer of the races of Europe to American soil. The East European Hebrew, who has a very round head, becomes more long-headed; the south Italian, who in Italy has an exceedingly long head, becomes more short-headed; so that both approach a uniform type so far as the roundness of the head is concerned. Fig. 1 shows at 1 and 1 the cephalic index of foreign-born Hebrews and Sicilians; at 2 and 2 that of those born within ten years after the arrival of their mothers in the United States; at 3 and 3 that of those born more than ten years after the arrival of their mothers in the United States. The diagram shows the very rapid approach of the two types among children born shortly after the arrival of their mothers in America, and the slower continuation of this approach among those born later. Fig. 2 roughly indicates the general form of (1) the foreign-born Hebrew, (2) the foreign-born Sicilian, and (3) the average form of the head of the American-born Hebrew and Sicilian-born more than ten years after the arrival of the mother in America.

2. The influence of American environment upon the descendants of immigrants increases with the time that the immigrants have lived in the country before the birth of children.

3. The changes in head form consist in the increase of some measurements and in the decrease of others. The length of the head of Hebrews is increased; the width of the head and the width of the face are decreased. Among the Sicilians the length of the head is decreased, the width increased, but the width of the face is decreased.

4. The differences in type between the American-born descendant of the immigrant and the European-born immigrant develop in early childhood and persist throughout life.

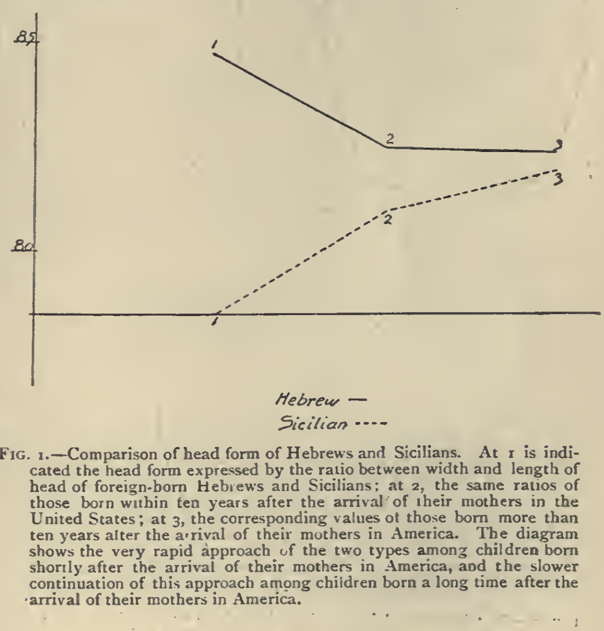


FIG. 1.—Comparison of head form of Hebrews and Sicilians. At 1 is indicated the head form expressed by the ratio between width and length of head of foreign-born Hebrews and Sicilians; at 2, the same ratios of those born within ten years after the arrival of their mothers in the United States; at 3, the corresponding values of those born more than ten years after the arrival of their mothers in America. The diagram shows the very rapid approach of the two types among children born shortly after the arrival of their mothers in America, and the slower continuation of this approach among children born a long time after the arrival of their mothers in America.

5. Among the East European Hebrews the environment, even in the congested parts of the city, has brought about a general more favourable development of the race, which is expressed in the increased height of body (stature) and weight of the children. The Italian children, on the other hand, show no such favourable influence of American environment, but rather a small loss in vigour as compared to the average condition of the immigrant children; so that it appears that the south Italian race suffers under the influence of American city life, while the East European Hebrew develops under these conditions better than he does in his native country.

6. The type of the immigrant changes from year to year, owing to a selection which is dependent upon the economic conditions of the country. This is shown by the fact that after the panic of 1893 a sudden decrease in the general development of immigrants may be observed, which persisted for several years. A similar change seems to have taken place

[1] "Changes in Bodily Form of Descendants of Immigrants." The Immigration Committee, Document No. 208 presented to the 61st Congress, 2nd Session. (Washington, D.C., U.S.A., 1910.)

after the panic of 1907. The significance of these changes is at present obscure.

7. It has been observed that, while immigrants have large families, the size of the family is very materially reduced in the second generation. This reduction of the size of the family goes hand in hand with the improvement of the physical development of the individual, as is demonstrated by the fact that children belonging to small families are considerably taller than children belonging to large families.

In connection with this last statement it is worth noticing that Prof. Boas points out that statistics taken on the school children of Toronto, Ont., and Oakland, Cal., show that there is a decided decrease in development of the individuals according to the increasing size of the family, and the Toronto material proves that the decrease in stature with increasing size of family takes place on every economic level. This

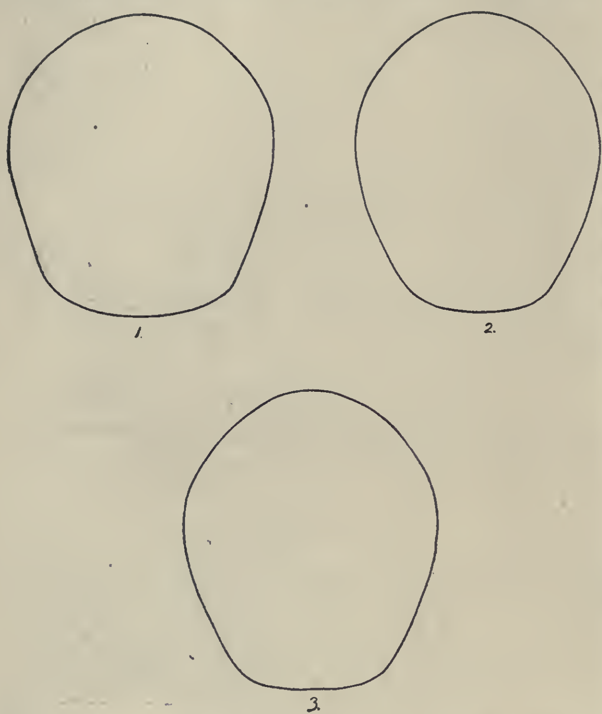


FIG. 2.—Sketches of head forms. Showing (1) the average form of the head of the foreign-born Hebrew; (2) the average form of the head of the foreign-born Sicilian; (3) the average form of the head of the American-born Hebrew and Sicilian born more than ten years after the arrival of the mother in America. These sketches are intended only to give an impression of the change in proportion. They do not represent the head forms in detail.

does not seem to be due entirely to inherited physiological causes nor to differences of nutrition. The fact, however, comes out with greatest clearness that reduction in the size of families goes hand in hand with the improvement of physical development.

The data upon which these conclusions are based are given in tables of measurements, and synthesised in curves. Their trustworthiness depends upon several conditions being carefully investigated. The wide experience of Prof. Boas as a physical anthropologist and his mastery of statistical methods give us confidence that his conclusions are well founded. He acknowledges that the problem is an exceedingly complicated one, and he describes the various ways in which he has endeavoured to arrive at trustworthy results; for these the reader is referred to the report.

One of the most important problems of physical anthropology is to determine what effect environment has upon the human species. In his address to the Anthropological Section of the British Association at the Dublin meeting in 1908, and again in his presidential address to the Royal Anthropological Institute on "The Influence of Environment on Man," delivered on January 25, 1910 (which will shortly be published), Prof. W. Ridgeway has directed attention to this question. Reference may also be made to Dr. R. Humphrey Marten's presidential address to the South Australian Branch of the British Medical Association (Adelaide, 1900), on "The Effects of Migration from the Northern to the Southern Hemisphere." The investigations Prof. Boas is now undertaking are of prime importance, as they are based on careful measurements, but many more similar studies must be made before general conclusions can be drawn. It is also obvious that this is not a matter of purely anthropological interest, but is of significance to the sociologist, and should not be neglected by the statesman.

A. C. HADDON.

PRESENT CONDITION OF AMERICAN BISON AND SEAL HERDS.

FROM the third annual report of the American Bison Society, recently published at Boston, we learn that the condition and prospects of the three herds of bison maintained by the Government of the United States are all that can be desired, and that, in the opinion of Dr. Hornaday, the future of the species is now secured. These herds comprise one in the Yellowstone Park, with ninety-five head, a second in Wichita, with nineteen head, and a third in Montana, with forty-seven head, the total number of animals thus being 161. Of these herds the one in Montana, which occupies a tract of twenty-nine square miles, has only recently been brought together (as described in the present report), and promises to be the best of the three. Indeed, Dr. Hornaday is of opinion that this herd alone would be sufficient to safeguard the species against extinction, since, owing to the extent of the area on which it is established, it is secure against any ill-effects from in-breeding. Regarding the Yellowstone herd, Dr. Hornaday is less confident, as the relatively small tract on which it is kept may lead to deterioration. The Wichita herd, on the other hand, is as well situated as the one in Montana.

In another part of the report is given a census of the total number of pure-bred bison living in captivity in America on May 1st, 1910. This total is 1633, against 1592 in 1908, and 1010 in 1903, thus showing a well-marked and progressive increase. Out of the 1633, 626 are in Canada, and the remaining 1007 in the United States. In 1903 Canada possessed only forty-one head, the enormous increase being apparently due to the transference of the Pablo herd from the United States. Of wild bison the total number is estimated at 475, of which twenty-five are in the Yellowstone, and the remaining 450 in Canada. In 1908 the number of wild Canadian bison was estimated at 300. The grand total of pure-bred animals living in North America is thus approximately 2108, against 1917 in 1908.

A considerable portion of the Montana herd was purchased from Mrs. Conrad, of Kalispell, in that State, who also presented the magnificent herd-bull shown in the foreground of the illustration herewith reproduced.

The selected portion of the Conrad herd was driven by cowboys, without any noise, to the nearest railway siding. Here "each animal was driven singly into the corral that communicated with the loading chute.

. . . The chute of a railway cattle-yard is a long, narrow cañon with wooden walls, sloping upward rather steeply, and ending in the open door of a cattle-car. . . . A crate was placed in the middle of the chute; the sliding door at the outward end of the box was lifted high and carefully poised for a quick drop. An animal specially fitting the crate was then cut out from the bunch, driven into the chute, driven on into the crate, and shut in with a bang. After that the crate was hauled and shoved into the stock-car and settled in its place."

In NATURE of July 28 appeared a paragraph relating to the danger threatening the Alaskan fur-seals owing to unrestricted pelagic sealing by the Japanese. Since that paragraph was written the editor has received a copy of an "open letter" addressed by the Camp-Fire Club of America to the people of the United States, together with certain letters addressed by the committee of the club to Mr. Secretary Nagel, and the replies to the same. From a covering letter it appears that the Camp-Fire Club comprises about 350 members, all interested in the preservation of American big game, and the opinions of whom ought therefore to carry considerable weight. According to the "open letter," the Pribilov Islands, when purchased from Russia about the year 1867, were the resort of at least 4,500,000 fur-seals, or sea-bears; at the present day the number is only from 30,000 to 50,000. Formerly the islands yielded a large revenue to Government; now they involve a heavy expenditure. The Camp-Fire Club is of opinion that all slaughter of seals on the islands should be prohibited for ten years, in order to permit of the recuperation of the herds to a point when they will yield an annual revenue of 200,000*l.*, and at the same time to make treaties with the British, Canadian, Japanese, and Mexican Governments for the suppression of pelagic sealing, the latter being an even more urgent matter than the former.

The secretary to Government, on the other hand, acting apparently on expert advice, demands a renewal of a killing licence on the ground that unless 95 per cent. of the younger male seals are annually killed the "surplus bulls" will fight with "the breeding bulls" over the females, and seriously retard the breeding of the herd. To this the committee, after indicating their opinion of the experts concerned by printing the word with inverted commas, make the following reply:—"As if a wild species does not know how to breed and multiply successfully without the help of man! The excuse is most inadequate, and in any event it is no excuse whatever for not dealing squarely with Congress, and in accordance with a very plain understanding."

From this it will be manifest that the controversy has entered a somewhat acute and embittered stage, the details of which I have neither space nor inclination to discuss. If, however, pelagic sealing weighs heavily, as I understand it does, on female seals, there may be something in the contention that a certain number of young males should be annually killed off, although 95 per cent. certainly seems a heavy toll. On the other hand, there is no doubt whatever that unrestricted pelagic sealing should be stopped, this being a matter, not of American, but likewise of world-wide interest. R. L.

The Best Bull Bison in the Montana Herd. (From the Third Annual Report of the American Bison Society.)

THE FUTURE OF AGRICULTURAL RESEARCH IN GREAT BRITAIN.[1]

THE announcement recently made to the effect that the Board of Agriculture has applied for a large sum of money from the development grant for the purpose of aiding agricultural research lends a peculiar interest to two publications just issued, the report of the Board of Agriculture on the grants made for the last two years for agriculture education and research, and the statement of the British Science Guild recently submitted to the Prime Minister in an influentially signed memorial. The report may

[1] Report on the Distribution of Grants for Agricultural Education and Research in the Years 1903–9 and 1909–10. Board of Agriculture and Fisheries. Cd. 5388. Price 7½*d.*
The British Science Guild. The Present Position of Agricultural Research in the United Kingdom.

be taken as an indication of the official attitude, and the memorial as the attitude of the professed man of science, towards agricultural research, and it is interesting to compare them, to see what they have in common and how far their differences are fundamental.

From the fact that both publications, after a few preliminary statements, come straight to one and the same point, we may take it that this is regarded as the real issue: Does Research pay? The position of the Board of Agriculture is thus set out:—

A public department when authorising the expenditure of money on research is bound to take into consideration the probable value of the work to the State. It cannot rest satisfied with the assurance that sooner or later all accessions to knowledge will benefit the country. The taxpayer of to-day naturally wishes to see a return for his contribution, if not in his own lifetime at least in that of his children. It is obvious therefore that, as a matter of elementary justice, the question of time must receive consideration from any department entrusted with the expenditure of State funds on research.

On the other hand, the memorial states:—

The committee of the British Science Guild would urge very strongly that the value of investigation can rarely be translated directly into terms of pecuniary gain. The benefits lie more in the method of thought that is induced among the farmers and those concerned in advising them, in the stimulus it gives to a more exact conduct of the business of farming, in the confidence with which men take up the fresh resources which science and the industries are always putting at the disposal of agriculture, than in any sudden revolutions effected by research. The fact that the countries whose agriculture has made the greatest advances in recent years are those which pay the greatest attention to research is itself sufficient justification for the action of the British Science Guild in urging the British Government to move in this direction.

Between these two positions there is a great gulf, but one may hope that it will not prove impassable. The Board of Agriculture has recently appointed a committee, including several distinguished men of science, to advise on questions dealing with research, and doubtless a broad view will be taken of "the probable value" of a piece of really good research work. The memorial gives several instances where research has directly resulted in financial gain to farmers. An outstanding case is the use of superphosphate, which was discovered by Sir John Lawes, and has been of enormous benefit to farmers. Denmark affords at least two good illustrations. Sonne's work on barley has resulted in the general adoption of a particular type of malting barley, so that the yield has gone up three or four bushels per acre, and the malting quality has become more uniform. The whole butter industry is founded on scientific control. Nilson's work in Gothland, Sweden, is also mentioned. More than 30,000 hectares of this island consisted of sterile swamps. Nilson proved by careful investigations that the factor causing sterility was deficiency of phosphates; when these were supplied the richest crops of corn, rape, and sugar-beet could be secured. He further devised a suitable phosphatic manure out of a rather poor phosphatic mineral in the north of Sweden. Coming to our own Colonies, the control of live stock diseases in the Transvaal furnishes an illustration.

At the end of the war the whole country was ravaged by various diseases, which had reached the country at an earlier period, but had been distributed broadcast by the movements of horses and stock during the war—rinderpest, redwater, East Coast fever, in succession had attacked the cattle, until few were left in the colony, and importations died as rapidly as they were introduced. Sheep and horses were equally affected, until stock raising of any description seemed an impossibility. The investigations, however, conducted by Dr. Theiler for the Transvaal Department of Agriculture into the causes of these diseases have resulted in a number of methods of immunisation, which, coupled with veterinary regulations as to the movements of stock, are now rendering the country habitable by cattle again and the business of agriculture once more possible.

Many other instances might have been given, but the memorialists very wisely do not allow themselves to be drawn into a false position, and repeatedly urge that the results of research work cannot usually be translated direct into terms of general practice. They decline, in short, to regard the probable financial value of a particular piece of work as the only criterion of its usefulness. This is, of course, the position one expects from the British Science Guild, but it must also be remembered that the attitude of the Board is unquestionably that of a large body of the public.

In reading the two publications it becomes evident that the word "research" is used in rather a different sense in each of them. The Board's report states that "research must satisfy one or both of two conditions (1) it must, as a result of observation or experiment, result in the collection of fresh facts; (2) it must involve an examination of the facts collected, or phenomena observed, and the reduction of them to a form in which they constitute an addition to knowledge." This definition is not adhered to, and work that is primarily educational, such as demonstration trials and tests, is apparently classed as research. The memorial recognises the difficulty of drawing a hard and fast line, but adopts this as a working definition:—"Work which is published only in the annual reports of the institution may be regarded as educational, work also published by one of the learned societies or in the *Journal of Agricultural Science* may be treated as research."

This difference of view explains why the memorialists only put the number of colleges where research has been done at seven, whilst the Board consider that research is being done at all the colleges. So far as the demonstration trials are concerned the Board's position is sound; such demonstrations are intended to improve practice, and must obviously be judged on their profitableness. Only in regard to research proper is there any difference of opinion, and here the difference is fundamental. It would, however, be premature and ungracious to labour this point; the Board's advisory committee is only just appointed, and it is clear that an open mind prevails:—"It is not usually a difficult task to distinguish research from spurious imitations, on the other hand it may at times be difficult to say whether a particular piece of research is, or is not, entitled to receive aid from agricultural funds. One may be permitted to express the hope that the public interested will not take a narrow view on this point."

The object of the British Science Guild memorial was to urge the necessity of "granting adequate assistance for the continuous conduct of scientific investigations having for their object the development of agricultural production." No scheme is foreshadowed; indeed, any attempt would have been out of place.

The report of the Board of Agriculture, whilst it does not set out a scheme, discusses the general lines on which one might be based. In the first instance, "At the present time the number of well-qualified men engaged in agricultural investigation in this country is relatively small and one of our chief aims in expending additional funds should be to establish a system which will bring agricultural science suitable recruits." But when we come to inquire the meaning of "suitable recruits," we learn that "the

chief demand of the present time is for 'spade workers' and 'quarrymen' to prepare foundations and material." It is to be hoped that on this point at least the Board will allow itself to be converted. Unless men of outstanding ability can be attracted to the research stations and agricultural colleges, there is not much hope that the taxpayer will see anything like the return he ought for the money expended. This, indeed, is the vital question; if the right sort of men are got to do the work all the other questions of administration sink into insignificance. But here also the Board is on what appears to be the safe ground. The idea of a central experimental station is dismissed, and a wider policy is suggested:—"It would probably be advisable, therefore, to use part of the Development Fund in making such grants to universities and university colleges as would induce them to make provision for agricultural research."

At no period in its history has agricultural science had a greater opportunity than at present. It is no longer hampered by lack of funds or by apathy on the part of the farmer. The problems are more numerous and more interesting than ever they were. But unfortunately the workers are few, and fresh workers are not readily forthcoming. The hopeful feature is that a number of eminent men of science are giving up time and thought to the organisation of the new work, and, further, that the Board of Agriculture and the large agricultural societies are manifestly and genuinely anxious to render all the help they can.

RATS AND PLAGUE.

ALTHOUGH the recent epidemics of bubonic plague in China, India, and other parts of the world have been always associated with outbreaks of the same disease amongst rats, the historical study of plague throughout the world reveals the singular fact that previous to 1800 very few references to a coincident mortality amongst rats have been put on record. Many excellent accounts of the older outbreaks, notably of the Black Death in Europe in 1347, and the Great Plague of London in 1665, are in existence, but careful research into these documents by modern historiographers—Haeser, Hirsch, Abel, and Sticker—has shown that for reasons difficult to discover very scanty mention of associated rat mortality has been made.

The earliest recorded instance is perhaps that given in the Bible in the account of the pestilence amongst the Philistines, which they ascribed apparently to "the mice that marred the land." Avicenna refers to the association between rats and plague in his description of the epidemic in Mesopotamia about the year 1000 A.D. Nicephorus Gregoras, writing of the Great Plague of 1348, which entered Europe by way of Constantinople, makes a similar reference. Rats are mentioned in connection with the plague in Yunnan about 1757, and later in 1871–3. In India an association between rats and plague is noted in the *Bhagavata Purana*, by the Emperor Jehangir in the plague epidemic of 1615, and in a report of the Pali plague in Rajputana in 1836. Lastly, Orraeus refers definitely to rat mortality in his account of the epidemic of 1771 in Moscow.

The identity of the disease in rats with that affecting man was established by the discovery in 1894 of *B. pestis* by Yersin and Kitasato.

Within the next few years the relationship between rat and human plague was investigated in many parts of the world—by Thompson and Tidswell in Sydney, Clark and Hunter in Hongkong, Snow, Weir, Hankin and James in India, and by Kitasato in Japan. In 1905 the Plague Research Commission was appointed to investigate plague in India, and the reports of this Commission represent the results of the most exhaustive inquiry into the subject that has yet been carried out.

The Commission early turned its attention to the relationship of rat plague and human plague, and instituted an extensive examination of the rats in Bombay and elsewhere for the presence of plague infection. The maps and charts, representing graphically the results of this examination, clearly show the correlation between the epizootic and the epidemic—the rat epizootic preceding the epidemic by an interval of ten to fourteen days. Every outbreak of bubonic[1] plague, when adequately investigated, was found to be associated with the disease amongst rats. The conclusion must be drawn that every epidemic of bubonic plague is caused by the concomitant rat plague.

In Bombay the rat population is an enormous one, *Mus decumanus* (the brown or grey rat) swarming in the sewers, gullies, and outhouses in the city, and *Mus rattus* (the black rat) living in countless numbers in the houses of the people. The latter species is of especial importance in plague epidemics, because it is essentially a house rat: it may almost be said to be a domesticated animal. The severity of the epizootics in the two species will be appreciated when it is stated that during one year the examination of 70,789 *M. decumanus*, taken from all parts of Bombay city, proved that 13,277 were plague-infected = 18·8 per cent., and that out of 46,302 *M. rattus* examined 4,381 were plague-infected = 9·4 per cent. The heavier incidence of plague in *M. decumanus* is explicable by the circumstance that the flea infestation of this species is more than twice that of *M. rattus*.

Some interesting observations on the distribution of different species of rats in India have been made recently by Captain R. E. Lloyd, I.M.S. The most common rats in India are *M. rattus*, *M. decumanus*, and *Gunomys* (*Nesokia bengalensis*). *M. decumanus* is common both in Bombay and Calcutta, but is absent from the city of Madras. It is significant that Madras is the one port in India which has never been seriously infected with plague. *M. rattus* appears to be universally distributed in India, whereas *M. decumanus* does not seem to occur in India except in seaports. *Nesokia bengalensis* is found in every part of India.

The question of the transportation of plague by ship rats is an extremely important one, but has not so far been thoroughly worked out. It would appear that *M. decumanus* is the species most commonly infesting ships, although *M. rattus* is also found.

Sticker, in his history of plague epidemics, quotes the statement that *M. decumanus* got into Europe from Persia about the year 1725. In England *M. rattus* was displaced by the invasion of *M. decumanus* about this time. At the present day the predominating species in this country is undoubtedly *M. decumanus*; *M. rattus* is, however, becoming increasingly common in the seaports.

An important question in plague epidemiology is the mode of conveyance of the infective organism from the plague rat to man. It is impossible even to summarise here the numerous experiments and observations on this subject, but it may be said that from many sides, and especially from experiments in the laboratory and in actual plague-infected houses, a mass of evidence has been raised which incriminates and indeed convicts the rat flea as the transmitting agent of the infection.

[1] Pneumonic plague differs from bubonic plague in its mode of spread. When a series of cases of plague pneumonia occurs, the infective organisms are conveyed directly from case to case by coughing and inhalation. It is probable that the usual source of infection in the first case of the series is a severe secondary pneumonia occurring in a patient with septicæmic plague.

In India the rat flea, *Loemopsylla cheopis*, which closely resembles the human flea, *Pulex irritans*, in appearance, is by far the most commonly found species. In England the common rat flea is *Ceratophyllus fasciatus*; a single specimen only of *L. cheopis* has been found up to the present time.

L. cheopis, especially if hungry, will bite man; *C. fasciatus* does not take to man with any readiness, but will undoubtedly bite on occasion. This difference in the appetite of the two species for human blood may be of significance in determining the likelihood of the spread of rat plague to human beings.

G. F. PETRIE.

PROF. D. P. PENHALLOW.

WE regret to announce that Prof. D. P. Penhallow, D.Sc., F.R.S. (Canada), president of the American Society of Naturalists, and professor of botany in McGill University, Canada, died on October 20, in consequence of an apoplectic seizure, whilst on board the ss. *Lake Manitoba*, on voyage to Liverpool. His remains were brought to Liverpool, and were, in accordance with his wishes, cremated at Anfield Cemetery on Friday, October 28. Prof. and Mrs. Penhallow were about to begin a year's vacation, and had intended spending the winter in the south of England. In consequence of the severe strain of work which Prof. Penhallow had undergone during the last few years, his previously excellent health had shown signs of giving way, and under medical advice he was about to take a prolonged rest, when the lamentable event of his decease occurred..

Prof. D. P. Penhallow was born in 1854 at Kittery Point, in Maine, where his parents had a summer cottage, but their home was in New Hampshire, and Prof. Penhallow always regarded himself as a New Hampshire man. His family were in the direct line of descent from Governor Wentworth, of pre-Revolutionary days, and Prof. Penhallow was a splendid embodiment of the best type of New Englander. He received his scientific education in Boston University, and after graduation he was offered the post of professor of botany in the Imperial College of Agriculture in Japan. In the same year (1876) he married Miss Sarah Dunlap, who, like himself, could boast of a distinguished New England ancestry, and the first four years of his married life were spent in Japan. He thus enjoyed the distinction of being one of the group of Western students who were chosen by the Reformed Japanese Government to inaugurate the epoch of Meiji (intellectual enlightenment) in Japan.

Returning to America in 1880, he undertook work in connection with the summer school of botany in Harvard University, and in 1883 he was offered the newly-created chair of botany in McGill University, Montreal, where the rest of his professional life was spent. He had a very uphill fight in Montreal, which he manfully fought. There was no botanical laboratory and there were no funds to provide one; but as Prof. Penhallow gained the respect and esteem of the community help was forthcoming, and before he died the botanical laboratory was exceedingly well equipped. When he was appointed obscurantist views prevailed in Montreal, both in the city and in the University, and Prof. Penhallow was one of the very first to teach evolution, and may thus be said to have helped to inaugurate the epoch of "meiji" in Montreal. In his own science he devoted special attention to the anatomy of woods, both recent and fossil; on this subject he published many valuable papers, and in his great work on "Gymnosperms," which appeared in 1908, he summed up the results of twenty years' labour. His eminence in his special department was cordially recognised by the American scientific world, and when he died he was not only president of the American Society of Naturalists, but vice-president of the American Society of Botanists.

But Prof. Penhallow's activities were by no means limited to teaching in his special subject. He threw himself into every movement calculated to bring a wider intellectual outlook into Montreal and Canada generally. He instituted courses of lectures to teachers, which had for many years a beneficial effect on those engaged in instruction in the public schools of the city. He was a leading member of the Canadian Royal Society, and in 1897, when the British Association met in Toronto, he was appointed a member of a committee to impress on the Canadian Government the desirability of founding a marine biological station. The Government acted in accordance with the advice of this committee, and in 1899 a small floating station was started, which was moved from placed to place in eastern Canadian waters.

When in 1907 the Government was persuaded to give a grant towards the foundation of a permanent station at St. Andrews, Prof. Penhallow was deputed by the Biological Board to supervise its erection. When he arrived at St. Andrews it was found to be necessary not only to build the station, but to cut a road through a mile of forest and to build a wharf. No one was ready to undertake the contract for this work, and those who were ready to undertake part of it, when they discovered that it was to be paid for by "Government money," would only do so at exorbitant prices. With characteristic American energy and versatility, Prof. Penhallow threw himself into the breach, became contractor himself, and constructed the road, the station, and the wharf in one-third the time he was told it would require, and at a great saving in cost. Next year he superintended the activities of the station, but a political crisis at Ottawa temporarily stopped supplies, and the anxiety and financial strain which he underwent undermined his health, and, in the opinion of his friends, constituted the first link in the chain of causes which led to his death.

Prof. Penhallow is survived by his wife and by his son, Dr. P. Penhallow, who is engaged in medical practice in Boston. By his death McGill University loses one of its most distinguished professors, the city of Montreal one of its most public-spirited citizens, and the science, not only of botany, but of marine biology generally, a devoted supporter who could ill be spared.

E. W. M.

NOTES.

WE learn with great regret that it has been found necessary to postpone the festivities arranged to take place at Leyden to-day (November 3). On this date Prof. van Bemmelen completes his eightieth year, and he was to have received the personal congratulations of friends and disciples from all parts of the world. Owing to his illness, the ceremony is to be confined to the formal presentation of the jubilee volume by Prof. Lorentz, if, as is hoped, Prof. van Bemmelen is sufficiently recovered to receive him. The jubilee volume is a remarkable testimony to the regard which is felt throughout the world for the distinguished second founder of colloidal chemistry. It contains a portrait, together with a biography and a bibliography of the professor's published works. Sixty papers on subjects connected with the colloidal state have been contributed by workers from all parts of the world. Amongst the authors are le Chatelier, Duhem, Zsigmondy, Liesegang, von Wiemarn, Hissink, Freundlich, Biltz, Spring, Hardy, Svedborg, Jordis, Wolf. Ostwald, Lotter-

moser, Nietzk, Spiro, Bechold, Tamman, Barus, Bredig, Lorenz, Malfitano, &c. The volume is published by C. de Boer, Helder, Holland.

THE Allahabad *Pioneer Mail* of October 7 contains a melancholy review of a resolution recently passed by the Punjab Government regarding the prevention of plague. This resolution records that, in the opinion of a committee consisting of plague experts and district officers of experience, "no remedy has been found for the disease; that the people generally will not go to plague doctors to be treated when suffering from plague; that disinfection of houses by means of chemicals, or even by heat, as a means for checking or preventing an epidemic is useless; that rat destruction by poison or trapping is almost equally useless; and that inoculation, though a splendid means of individual protection, cannot be used to check the epidemic owing to popular prejudice." As the result of this, the Punjab Government propose, while keeping on the field the establishment of plague doctors, to reduce the cost if possible, and make suggestions as to how this can be done. It is not easy from this report in the *Pioneer Mail* to analyse the evidence upon which the Punjab Government acts, but the paper must cause melancholy reflections among the friends of India. Is it not true that the words *non possumus* are somewhat frequently heard from the mouth of the Government of India? We have just listened to them in connection with malaria prevention, and we have heard them over and over again in connection with the prevention of cholera. Perhaps a complete reform in the sanitary service of the country, with much more attention to sanitary investigation and a more generous employment of trained scientific workers, would not only save the Government the waste of much money on fruitless efforts, but would also do more to ensure success in the future.

COLONEL W. C. GORGAS, who has done such splendid work in removing mosquito-borne diseases from the Panama Canal zone, sends a short letter to the *Times* of October 28 in which he gives the death-rates for that area; and they are so remarkable that we here reprint his facts. Colonel Gorgas says:—"For the years since our occupation the statistics for the city of Panama have been as follows:—

Year	Population	No. of deaths	Death-rate per 1000
1905	21,984	1,447	65·82
1906	25,518	1,142	44·75
1907	33,548	1,156	34·45
1908	37,073	1,292	34·83
1909	40,801	1,038	25·44

The rates for the Canal Zone, under American jurisdiction, including the cities of Colon and Panama, are as follows:—

Year	Population	No. of deaths	Death-rate per 1000
1905	56,624	2,828	49·94
1906	73,264	3,544	48·37
1907	102,133	3,435	33·63
1908	120,097	2,983	24·83
1909	135,180	2,459	18·19

Among employés the rates have been as follows:—

Year	Employés	Death-rate per 1000
1905	16,511	25·86
1906	26,475	41·73
1907	39,343	28·74
1908	43,890	13·01
1909	47,167	10·64

There has been no case of either plague or yellow fever on the Isthmus since 1905. We admitted to our hospitals for malaria in the year 1905, 514 cases for each thousand employés; in 1906, 821 cases for each thousand employés; in 1907, 424 for each thousand employés; 1908, 282 for each thousand employés; and 1909, 215 for each thousand employés."

THERE seems little doubt that the four deaths reported recently at Freston, in Suffolk, were due to plague. To prevent any further development of the disease, active measures are being adopted to effect a general destruction of rats in Freston and the neighbourhood. The southern part of rural Ipswich has been systematically explored, and large quantities of poison laid down. The Samford Rural District Council has issued a warning notice pointing out that it is dangerous to touch dead rats with the naked hand, and urging their burial without delay. The public has been requested not to eat rabbits or hares killed in the district. The notice also urges a general campaign against uncleanliness and insects. The question of destroying rats over a wider area than that proposed has been raised, as many dead rodents have been found north of the Orwell. It is pointed out that the increase of rats can be traced to the practical extinction of their natural enemies—owls, kestrels, and hawks, which are now seldom seen in the locality. The origin of the disease is still uncertain, but there is reason to believe, in view of the plague at Odessa, that grain vessels from the Black Sea to the River Orwell may have brought over plague-stricken rats. The position of knowledge as regards the relation between rats and the spread of plague is described in an article elsewhere in this issue.

IN the gardens of the Zoological Society of London, Regent's Park, there is now in flower a specimen of *Agave Americana*. The Agaves are popularly known as "American" Aloes; but there are no true Aloes in America, the genus being almost entirely confined to South Africa. Agave is a member of the natural order Amaryllidaceæ, and Aloë of the natural order Liliaceæ. Another popular fallacy connected with the Agaves is the belief that the plants flower after 100 years and then die, hence the Agave is sometimes called the century plant. The facts are these, that the plants, being monocarpic, are only capable of flowering once, but the age at which a particular specimen will flower is determined by many circumstances, including constitutional characters and the suitability or otherwise of the conditions in which the plant is growing. These remarks apply specially to *Agave Americana*, for another species, namely, *A. Sartori*, is capable of flowering from year to year. *A. Americana* has very thick leaves of from 4 feet to 6 feet in length. They have sharp prickles all along the margins, and each leaf has a stiff, sharp point 1 inch to 2 inches long; these latter are sometimes called "Adam's needles." The plant contains fibre in the roots and leaves, and the fibre is used for commercial purposes. Agaves are cultivated for ornamental purposes in this country, being used frequently as terrace plants in large boxes or tubs. The flower spikes grow very rapidly when once they have formed, their height varying from about 15 feet to upwards of 20 feet. The numerous flowers are greenish-yellow, occasionally quite yellow, but scarcely golden as they are sometimes described. The plant which is now flowering at Regent's Park has stood out of doors during the summer, but it is blooming in the warm atmosphere of the reptile house. Another specimen bloomed in the same gardens in 1906, and two specimens flowered in the Victoria Park, London, in 1902. In Mr. Smith's gardens in the Scilly Islands a dozen or more specimens flowered out of doors in 1875, and in the south of France Agaves in flower are not un-

common objects. There is a variegated variety of *A. Americana* which is more ornamental than the type.

It is announced in the *Revue scientifique* that Prof. Kammerling Onnes, of the University of Leyden, has put his cryogenic laboratory at the disposal of Madame Curie for her researches on radio-activity at low temperatures.

The daily Press has recently given currency to a vague report that a "vast lake" has been discovered in an unexplored part of north-western Canada by Indians, which they declare to be as large as Lake Superior. The report is hardly likely to be correct so far as the size of the lake is concerned.

A course of twelve lectures on "The Coasts of Great Britain and Ireland" (Swiney lectures on geology) will be delivered by Dr. T. J. Jehu in the lecture theatre of the Victoria and Albert Museum, South Kensington, on Mondays and Tuesdays at 5 p.m., and Saturdays at 3 p.m., beginning Saturday, November 5. Admission to the course is free.

A Reuter message from Vienna states that on October 28 the Radium Institute created there by the Academy of Sciences was formally opened by the Archduke Rainer. The new institute is to be devoted solely to chemical and physical research, and will be open to scientific men of all countries. The institute has at its disposal three grams of radium from Joachimsthal.

At the annual general meeting of the Cambridge Philosophical Society, held on October 31, the following officers were elected:—*President*, Sir George H. Darwin, K.C.B.; *vice-presidents*, Dr. Fenton, Prof. A. C. Seward, and Prof. H. F. Newall; *treasurer*, Prof. E. W. Hobson; *secretaries*, Mr. A. E. Shipley, Dr. Barnes, and Mr. A. Wood. The new members of the council elected are Mr. E. A. Newell Arber, Sir Joseph J. Thomson, and Mr. J. E. Purvis.

The Chemical Society's banquet to past presidents, which was postponed from May 26, will be held at the Savoy Hotel (Embankment entrance) on Friday, November 11. The banquet is in honour of the following past presidents who have attained their jubilee as fellows of the society:—Prof. William Odling, F.R.S., the Rt. Hon. Sir Henry E. Roscoe, F.R.S., Sir William Crookes, F.R.S., Dr. Hugo Müller, F.R.S., and Dr. A. G. Vernon Harcourt, F.R.S.

The Berlin correspondent of the *Times* states that the German Ministry of the Interior has called a meeting to be held within the next few days to consider whether the foundation of a special institute for aviation research is practicable, or whether the work can be better carried out by existing institutions. Delegates from the Imperial Government and the Federal States will be present, together with representatives of the German technical universities, of various associations connected with aviation and motors, and of the industries concerned.

The death is announced of Dr. D. J. B. Gernez, member of the Paris Academy of Sciences and a former collaborator of Pasteur. From a notice in the *Times* we learn that Dr. Gernez was born in 1834. On the completion of his studies he filled various posts as a teacher of scientific subjects. While engaged upon professorial work at the Lycée Louis-le-Grand he assisted Pasteur in some of his researches, and was for many years an intimate friend and collaborator of the great French investigator. For more than twenty years Dr. Gernez was a lecturer at the Ecole Normale of Paris, a post which he held simultaneously with professorships at other great educational institutions, and from which he retired in 1904. Dr. Gernez was the author of a number of treatises on scientific subjects, and was an Officer of the Légion d'Honneur.

At the general meeting of the Royal Society of Edinburgh, held on October 24, the following office-bearers were elected:—*President*, Sir William Turner, K.C.B., F.R.S.; *vice-presidents*, Prof. Crum Brown, F.R.S., Prof. J. C. Ewart, F.R.S., Dr. J. Horne, F.R.S., Dr. J. Burgess, Prof. T. Hudson Beare, Prof. F. O. Bower, F.R.S.; *general secretary*, Prof. G. Chrystal; *secretaries to ordinary meetings*, Dr. C. G. Knott, Dr. R. Kidston, F.R.S.; *treasurer*, Mr. J. Currie; *curator of library and museum*, Dr. J. S. Black; *councillors*, Prof. J. W. Gregory, F.R.S.; Dr. A. P. Laurie, Prof. Wm. Peddie, Prof. H. M. Macdonald, F.R.S., Prof. D. Noël Paton, Dr. W. S. Bruce, Prof. F. G. Baily, Dr. J. G. Bartholomew, Dr. R. H. Traquair, F.R.S., Prof. James Walker, F.R.S., Prof. A. Robinson, and Dr. W. S. M'Cormick.

A meeting of the Optical Convention executive committee was held on October 25 in the rooms of the Chemical Society to consider the desirability of holding a second convention in the year 1912. On the motion of Dr. R. T. Glazebrook, C.B., F.R.S., it was resolved that a meeting of the permanent committee, which all members of the trade and others interested be invited to attend, be held some time in November to consider what action should be taken with the view of organising an optical convention in 1912. The time and place for this meeting will be announced as early as possible. The chair will be taken by Dr. Glazebrook, director of the National Physical Laboratory, as chairman of the permanent committee, and a statement of the principal matters to be brought forward for consideration at the meeting will be published in due course.

The magnetic survey yacht *Carnegie* left Para, at the mouth of the Amazon, under the command of Mr. W. J. Peters, on October 15, bound for Rio de Janeiro. This vessel, since leaving Brooklyn last June on her present cruise of three years in the Atlantic, Indian and Pacific Oceans, had covered nearly 7000 miles up to Para, during which portions of the first cruise were several times intersected by the introduction of loops. It is reported that the magnetic results obtained on the present cruise up to Para have fully confirmed the errors revealed by the first cruise in the existing magnetic charts of the North Atlantic. From Rio de Janeiro the *Carnegie* will proceed to Montevideo and Buenos Aires, and thence across to Cape Town, where she is due towards the end of March, 1911. At the latter port the director, Dr. Bauer, expects to rejoin the vessel, and be with her on the portion of the cruise in the Indian Ocean. *En route* to Cape Town, Dr. Bauer is to visit certain magnetic institutions in Europe in order to perfect arrangements for coöperative magnetic survey work.

The *Morning Post* National Fund Airship made a flight from Moisson to Aldershot on October 26. The airship left Moisson at 10 a.m. (French time), the coast of France near St. Valery en Caux at 12 noon, passed over the English coast-line near Rottingdean at 2.18 p.m., and reached Aldershot at 3.28 p.m., being brought to earth at 4.5 p.m. The distance of 197 miles was accomplished in 5h. 28m. The rate of speed was about 36 miles an hour, including partially adverse wind conditions. The airship carried a crew of eight. During the journey 528 lb. of ballast were used; 400 litres of petrol were consumed by

the engines, and at the moment of landing there were 880 lb. of water ballast, 990 lb. of petrol in reserve, in addition to at least 200 litres in the reservoirs. The engines started at 850 revolutions; they then worked up to 900 revolutions, and fell again to 850, and only finally during the landing worked at their full power of 1000 revolutions. The highest altitude reached was 2120 feet, and throughout the sea passage there was a steady level of about 200 feet. The overall length of the airship is 337·75 feet, and the water- and gas-proof envelope has a capacity of 353,165·8 cubic feet.

An appeal is made for funds to erect a new building for the Royal Society of Medicine. Of the sum required, the society has already provided 17,000*l*., and it asks that not less than 26,000*l*. may be contributed from without, so that it may not be compelled to curtail its very valuable public and scientific work. Towards the money in hand 8500*l*. has been subscribed by members of the medical profession. The Lord Mayor has become chairman of a Mansion House committee formed to promote the raising of upwards of 30,000*l*. for the new building. The governor of the Bank of England has opened an account for the receipt of donations, which may be sent to the Bank of England, payable to "The Royal Society of Medicine Building Fund," or to the Lord Mayor at the Mansion House. The society now has 3200 fellows and members, and possesses a library of nearly 100,000 volumes. It was originally founded in 1805, under the name of "The Royal Medical and Chirurgical Society." A new charter was granted it in 1905 under the new name of "The Royal Society of Medicine."

SEVERAL of the Parisian hospitals entertained their visitors last Christmas to kinematograph exhibitions, in which very realistic phases in the life-history of various pathogenic organisms were thrown on the lantern screen. On October 28 Messrs. Pathé Frères, of Paris, gave the members of the Medical Society of King's College Hospital an opportunity of seeing some of their most successful applications of the kinematograph to bacteriological photomicrography. The films shown represented (1) the experimental production of sleeping sickness in a rat, and the movements of the trypanosomes in the blood; (2) the spirochæta of recurrent fever, and the ticks which convey the parasite; (3) the spirochæta of fowls, some of which were seen imprisoned and revolving within the red corpuscles; (4) the movements of the infusoria from the intestine of a mouse; (5) *Trypanosoma lewisi* of the rat; (6) *Spirochaeta pallida*, which, although only 1/2000th of a millimetre in width, could be followed in its movements across the field of the microscope. Other films were shown representing involuntary movements of the embryo of the Axolotl and its emergence from the egg, and the movements of the human stomach as seen during an X-ray examination of a patient. There can be no doubt that these films are a triumph of technique, but the gain at present is rather in favour of the public entertainer than of the worker in science. The main advantage from a scientific point of view is that rapid movements may be slowed and analysed, while slow movements may be accelerated, and thus realised. Such films will become an essential part of the equipment of every physiological and medical workroom.

THREE years ago the council of the Royal College of Surgeons, England, instituted demonstrations in connection with the museum. At one of these, given in the theatre of the college on October 28, the conservator, Dr. Arthur Keith, showed a series of specimens illustrating irregularities in the differentiation of sexual characters. The museum is peculiarly rich in specimens of this nature owing to the fact that John Hunter, its founder, had preserved many preparations which illustrated the influence of the sexual organs in determining the growth and features of many parts of the body. Amongst these are the specimens which show the assumption of the male plumage of aged pea-hens and hen pheasants. Preparations added to the museum by Mr. S. G. Shattock show that such an alteration of secondary sexual characters is accompanied by a change in the sexual glands, usually of an atrophic nature. A Leghorn fowl, in which the external characters were those of a cock rather than of a hen, had genital glands of an ovo-testicular type. The Hunterian preparations, illustrating the sexual organs of the "Free-Martin"—a form of ox born as the twin of a perfect bull calf—were also exhibited. Although these specimens had been preserved for more than 150 years, their tissue was in perfect condition for microscopical examination. In one case Hunter was of opinion that both testes and ovaries were present in the same individual (a true hermaphrodite), but on microscopical examination it was found that the "ovary" was really a mass formed by a remnant of the Wolffian body. A higher vertebrate with both testes and ovary has not yet been seen. Hunter explained all irregularities in the development of the accessory sexual organs and of "secondary" sexual characters as the result of an "imperfection" in the development of the testis and ovary. All museum specimens and recent experiments are in favour of his interpretation.

THE third part of the fourth volume of Memoirs of the Peabody Museum is devoted to an account by Mr. Teobert Maler of a series of adventurous journeys starting from the north of Yucatan and extending to the great lake of Peten-itza, in Guatemala. The value of the memoir would have been enhanced by a sketch of the routes, which are not traceable on ordinary maps. Several important sites representative of the Maya-Toltec culture were identified, such as Motul, where a remarkable stela depicting a pair of dancing priests was found, Tubusil, Silbituk, and the remarkable island city of Itza-Flores. When the country passes under the control of a decent government the great lake of Peten will be brought into connection with the sea, and vast economical resources of this region will be developed, with the result that the remarkable ruined cities connected with the career of Cortes will receive adequate examination.

IN the *Oxford and Cambridge Review* for Michaelmas term Dr. A. Smythe Palmer concludes his study on the luck of the horse-shoe. He arrives at the conclusion that it is derived from the cult of the new moon, which was adopted by primitive races as a symbol of recovery and good fortune. Incidentally, he has collected some curious examples to show that the symbol was regarded as possessing magical power among the prehistoric people of Europe, as is proved by various records of the discovery of horse-shoes in ancient interments, by the shape of many tumuli, and by the ring of trilithons at Stonehenge. He further points out that, following Babylonian precedent, the rising moon lying on her back was believed to be a silver boat. He thus disposes of the controversy between two sets of people who use the talisman in our days—one preferring to fix it with the heels upwards, the other downwards—in favour of the former.

IN the *Field* of October 22 Mr. Lydekker points out that the new antelope described in NATURE of September 29 (p. 397) as *Strepsiceros buxtoni*, with the alternative name of *Tragelaphus buxtoni*, should be known by the latter title.

IN the *Zoologist* for October Mr. F. J. Stubbs adduces further evidence, especially an Act of 1564 (2 Eliz. c. 15), to show that egrets were formerly common in England. "At the middle of the sixteenth century England was the home of an egret that was highly esteemed for the table. It nested with us, and was protected by law; and the same, or an allied, species inhabited an adjacent part of the Continent, and was brought to this country alive for food. Probably the bird was not altogether white, thus differing from any existing European egrets or herons, and resembling species now found in America."

VARIATION in the oyster-boring whelk (*Urosalpinx cinereus*) forms the subject of an article by Dr. H. E. Walter in the October number of the *American Naturalist*. This mollusc is a native of the Atlantic coast of North America, but was unavoidably introduced when oysters were transplanted to the Pacific shore. It was the original object of the article to compare these introduced Californian whelks with their Atlantic prototypes, but comparisons were extended to a wider basis. As the result of the investigation, it appears doubtful whether Urosalpinx is more variable in its new than in its original home.

As fossilised birds' feathers have hitherto been recorded from only some fourteen localities—with one exception of Tertiary age—brief reference may be made to Mr. F. Chapman's description in vol. xxiii., part i., of the Proceedings of the Royal Society of Victoria, of a fossil of this nature from the Tertiary ironstone of Redruth, Victoria. No definite determination of the genus of the specimen, which is in the form of impressions on the two halves of a split nodule, is attempted, although it is suggested that it may have belonged to one of the smaller waders, such as the ibises.

THE third botanical number of the current volume of the *Philippine Journal of Science* contains a compilation of new or noteworthy Philippine plants, and a sixth part of an index to Philippine botanical literature, both prepared by Mr. E. D. Merrill. Among the new plants, about a hundred in number, mostly trees or shrubs, there are eleven additions to the genus Ardisia, ten to Ixora, and six to Hiptage; also new genera, Astrocalyx and Cephalomedinilla, are proposed under the family Melastomaceæ, Curraniodendron under Saxifragaceæ, and Pygmæopremna under Verbenaceæ. With reference to Ixora, it is noted that *Ixora coccinea* does not grow wild, but a closely allied species, *I. philippinensis*, is abundant and widely distributed.

AN enumeration of twenty-eight flowering plants and ferns growing on a London building site, about half an acre in extent, in Farringdon Street that has been vacant for two years is communicated by Mr. J. C. Shenstone to the *Selborne Magazine* (October). As the author points out, the chief interest lies in the methods of distribution by which the plants have reached the spot, and he has classed them as wind-distributed, kitchen refuse weeds, and forage or packing weeds. It is extremely puzzling to find a growth of bracken fern, since the plant is very difficult to transplant, and the appearance of *Ficus Carica* is not immediately explicable. Three casuals, that is, plants not indigenous to Britain, are provided by *Epilobium angustifolium*, *Senecio viscosus*, and *Erigeron canadense*.

OF the flowers which undergo marked changes after fertilisation, tropical orchids afford some striking examples. For instance, it frequently happens that after the pollinia reach the stigma the flowers fade prematurely, the column swells, the stigmatic surface becomes enclosed, and eventually the ovules begin to develop. It would generally be assumed that these changes can only be induced by the stimulus of the pollen on the stigmatic surface, and the subsequent growth of the pollen tube. It has, however, been observed by Dr. H. Fitting, as is pointed out in the *Gardener's Chronicle* (October 29), that certain of these effects can be produced by inorganic means. Thus scratching the stigmatic surface suffices to cause premature withering, and the application of dead pollinia or an extract therefrom may bring about swelling of the column; but apparently development of the ovules does require the stimulus induced by the pollen grains penetrating the ovary.

AMONG the numerous articles now appearing in agricultural publications on the growth of sugar-beet in England, one, by Mr. Chas. Bathurst, M.P., in the *Agricultural Students' Gazette* (vol. xv., part i.) deserves some attention. The importation of beet sugar into Great Britain is steadily increasing, and amounted in 1908 to nearly eighteen and a half million pounds sterling in value. Much of this could be produced in England, but the operation of the sugar bounties rendered the industry financially impracticable. Now that the bounties are abolished by the Sugar Convention, active steps are being taken in several counties to start factories, which, in Mr. Bathurst's view, should prove distinctly profitable unless an excise duty is placed on the sugar. An average crop is given as 18 tons per acre, selling at the factory for 18*s*. per ton, or 16*l*. 4*s*. The cost of production, including the rent of the land, should not exceed 9*l*. per acre, leaving a profit to the cultivator of 7*l*. 4*s*. per acre.

THE summary of the weather issued by the Meteorological Office shows that for the eight weeks of autumn as yet expired the aggregate rainfall has been largely deficient over the entire area of the British Islands. The greatest deficiency occurs in the north of Scotland, where the total rainfall is only 2·89 inches, which is 6·24 inches less than the average of the corresponding period for the last twenty-five years. In the west of Scotland the deficiency is 5·13 inches, the aggregate rainfall being only 3·10 inches. In the north of Ireland the deficiency is 3·98 inches, and in the north-west of England 3·60 inches. In the south-east of England, which comprises London, the deficiency amounts to 1·16 inches. The duration of bright sunshine for the period is deficient, except in a few northern districts, the greatest deficiency being fifty-eight hours in the east of England and fifty-six hours in the Midland counties. The mean temperature was not very different from the average, but its maximum readings were lower than usual, the absolutely highest temperature since September 4 being 76°, in the Midland counties. Frost at night has, as yet, only occurred in a very few districts. The aggregate rainfall since the commencement of the year is not very different from the average, but there is an excess, except in a few of the northern districts. The duration of bright sunshine as yet this year is generally deficient, the deficiency exceeding one hundred hours in the eastern districts of England.

IN the Proceedings of the Amsterdam Academy of Sciences of June 25 Dr. W. van Bemmelen and Dr. C. Braak give a preliminary report upon the investigation of the upper air, begun at Batavia in 1909. The observatory is now equipped with registering balloons and suitable instruments, but it was thought advisable to proceed cautiously in using them so near to the sea before obtaining more knowledge of the drift of the upper currents by means of pilot balloons. The following data showing the

mean decrease of the temperature gradient per 100 metres of the lower 2 kilometres were obtained (1) above the land with a captive balloon and light wind; (2) above the land with a moderate westerly wind, with kites; and (3) above the sea (January 14–20), weather rainy, with kites; but the results are not strictly comparable, owing to differences of time of day:—

Metres	100–500	500–1000	1000–1500
Balloon ...	0·77° C. ...	0·57° ...	—
Kite (land)...	0·87 ...	0·72 ...	0·44° (<1500 M)
Kite (sea) ...	0·91 ...	0·59 ...	0·71

Further kite observations over sea gave for 1500–2000 m., 0·34°; 2000–2500 m., 0·50°; 2500–3000 m., 0·46°. At about 1000 m. the gradient shows a sudden decrease, probably due to the formation of cumulus clouds. The observations of wind direction for the period September–May show that the upper air-current has easterly components up to the greatest heights attained (10–15 km.). The average altitude of the west monsoon was 5·4 km. The upper easterly, as well as the lower westerly, winds were sometimes affected by strong northerly or southerly components. It is mentioned that diagrams of a registering balloon sent up on May 19, during the passage of the earth through the tail of Halley's comet, showed no other noteworthy feature than an inversion of temperature between 6 and 7 km.; the balloon burst at about 7 km.

THE various methods of finding the height of an airship are discussed by Captain Paul Renard in the *Revue scientifique* for September 17. Of the several methods of observing the height from the airship itself, Captain Renard considers that the use of the barometer affords the only practicable one. Of the methods of observing the height from the ground the large majority involve simultaneous measurement of several angles, and this is, in general, impracticable. Captain Renard considers that the best methods are by observation with a telemeter, coupled with a determination of the altitude, or by two simultaneous observations of the altitude at the instant the airship is in the vertical plane joining the two observers.

THE *Builder* for October 29 contains an illustrated article descriptive of the fine building now being erected in London for the Y.M.C.A. This building occupies an island site of some 33,000 square feet, bounded by Great Russell Street, Bedford Avenue, Tottenham Court Road, and Caroline Street. Reinforced concrete plays an important part, and has been employed for the solution of various structural problems of considerable magnitude. The building is not one of the reinforced concrete skeleton class merely sheathed in masonry, but rather is a combination of masonry with reinforced concrete, the latter material taking the duties hitherto very generally assigned to structural steel-work in modern architecture. Thus we find reinforced concrete columns, beams, and wall lintels forming the backbone of masonry features, and bearing a large proportion of the loads to be supported, yet without involving any noticeable departure from the familiar aspect of masonry. In some important respects reinforced concrete is exclusively adopted, as in floor, roof, gallery stairway, and swimming-bath construction, and in the form of exceptionally large girders. The details of the reinforced concrete work were prepared by Messrs. L. G. Mouchel and Partners, in accordance with the Hennebique system.

AN article by Mr. Fullerton L. Waldo on recent progress in the construction of the Panama Canal appears in the *Engineering Magazine* for October. Rapid progress has been made in the great lock-works and the huge dam that is rising at Gatun. The three lock flights divide the vertical distance to the 85-foot level between them, whereas the locks of the Pacific division have lifts of $33\frac{1}{3}$ feet and $54\frac{2}{3}$ feet respectively. The usable dimensions of the locks are 1000 feet by 110 feet, giving ample margin for even the new White Star liners, the overall dimensions of which are 890 feet in length and 92 feet in width. It is calculated that the lock-stair at Gatun will require about $1\frac{1}{2}$ hours for the transit; the Pacific locks will detain the vessels for about the same length of time. The total passage across the Isthmus will take about 10 to 12 hours. The train takes about $2\frac{1}{2}$ hours, so that passengers will probably prefer this method of transit. About 15 minutes are required to fill the lock chamber, but in case of need for haste the process can be completed in about half this time. The available water supply will allow of 48 lockages per day, which might mean an average of something like 80,000,000 tons of traffic annually as compared with 21,000,000 tons in the case of the Suez Canal and the 40,000,000 tons of the Sault Ste. Marie.

WE have received the first five numbers of a leaflet entitled *Hygieia*, which is published by the Bureau of the International Congress of Hygiene, which is to be held in Dresden in 1911. It contains notices with regard to the congress and brief abstracts of papers dealing with subjects appertaining to hygiene, *e.g.* sugar as a food-stuff, taverns as hospitals, cleansing of towns, &c.

MESSRS. NEWTON AND CO., Fleet Street, London, have issued a supplementary list of lantern-slides for the present session. Among many others, we notice numerous astronomical slides dealing with Halley's comet, the moon, and Greenwich Observatory; a set of slides showing Sicily and Messina after the earthquake; sets to illustrate eight lectures on India, drawn up by Mr. H. J. Mackinder for the Visual Instruction Committee; and slides showing aërial experiments and aëroplanes.

THE Penny Science Lectures at the Royal Victoria Hall, Waterloo Road, S.E., during November include:—November 8, "Early Men in Britain," W. Lower Carter, and November 22, "Liquid Air," Dr. R. Whittan Gray.

MR. H. K. LEWIS, of Gower Street, London, has published a catalogue of new books and new editions added to his well-known medical and scientific circulating library during July, August, and September of this year.

OUR ASTRONOMICAL COLUMN.

FIREBALL OF OCTOBER 23.—Mr. W. F. Denning writes:—"The fireball of Sunday, October 23, 8h. 12m., was observed at Kenley (Surrey), Ilford (Essex), and in Wales, as well as at other places. It appears to have passed over the sea N.E. of the mouth of the Thames at heights of 84 to 40 miles. The length of the luminous course was about 75 miles, and the velocity 19 miles per second. Radiant near α Arietis.

"The observation of the meteor from stations in Wales is interesting, and it is probable that the object was seen from a great many towns in England, for it appeared at a time when many people would be out of doors. The sky was, it is true, cloudy at some places and veiled the brilliant light of the meteor, but it was a very fine one, and gave several flashes as it slowly sailed along the E.N.E. as seen from the neighbourhood of London. It is important that if any further observations of an exact character were made they should be published, so that the flight of the object may be investigated accurately."

THE MOTION OF MOLECULES IN THE TAIL OF HALLEY'S COMET.—In a recent note in these columns (September 29, p. 404) attention was directed to some results published

by Prof. Lowell in which he showed that particles repelled by light-pressure along the tail of Halley's comet travelled with accelerating velocities. An important addition to these results is now published in No. 48 of the Lowell Observatory Bulletins. By comparing the images shown on direct photographs with those shown on contemporaneous objective-prism spectrograms, taken under conditions which permit the comparison, Prof. Lowell has educed evidence that the gaseous molecules of the tail were repelled by light-pressure.

A series of spectrograms, taken during April and May, shows that the constituents of the tail varied considerably from one date to another. But the evidence indicates that on May 23 about 70 per cent. of the radiations represented on the spectrograms was due to emission, the remaining 30 per cent. being taken up by the continuous spectrum. That is to say, that the knots previously measured, on the direct photographs for May 23, were composed chiefly of gaseous molecules. As these knots showed, by their accelerating velocities, the action of a repulsive force exerted from the sun, it follows that light-pressure is competent to repel gaseous molecules.

Confirmation of this important result is derived from a similar comparative study of the direct and spectral images of the tail of Morehouse's comet. The spectroscopic evidence in that case indicated that practically all the light recorded on the plates was emitted by gaseous particles, yet the direct photographs afforded evidence of the action of light-pressure.

THE DARK BAND SURROUNDING THE POLAR CAPS OF MARS.—Readers of these columns will remember the discussion raised by M. Antoniadi's contention that the dark band seen circling the polar cap on Mars is simply a contrast effect. In support of this contention M. Antoniadi stated (see NATURE, December 23, 1909, vol. lxxxii., p. 227) that photographs of the planet, taken in America, did not show the dark band, although at the same time they showed that the cap was not brighter than the continental areas, and therefore irradiation could not be adduced as the reason for the absence of the band. Prof. Lowell, in a note appearing in No. 4448 of the *Astronomische Nachrichten*, emphatically states that the photographs do show that the polar cap is brighter than the "continents," and actually irradiates in consequence beyond the confines of the disc. Further, the screen through which the photographs were taken was such that the relative brightness of the caps would be considerably modified.

THE SPECTRUM OF NOVA SAGITTARII NO. 2.—The nova recently announced by Mrs. Fleming appears on sixteen photographs taken at Arequipa between March 21 and June 10; the magnitude varied from 7·8 to 8·6 between those dates. The spectrum is quite faint, but shows the hydrogen lines, $H\beta$, $H\gamma$, $H\delta$, $H\epsilon$, $H\zeta$, and $H\eta$, bright; a trace of $H\gamma$ as a dark line is seen on the less refrangible edge of the bright $H\gamma$ line.

The star does not appear on seventeen photographs taken between July 23, 1889, and October 7, 1909, although stars down to magnitude 12·0 are shown on the majority of the plates; one plate shows the fifteenth magnitude or fainter.

A visual observation by Mr. Leon Campbell, using the Harvard 24-inch reflector on October 3, showed the magnitude of the nova to be 10·5.

Prof. Millosevich, on October 15, determined the position, reduced to 1910·0, as 17h. 54m. 26·28s., $-27° 32' 52·1''$, and the magnitude as 10·4 (*Astronomische Nachrichten*, No. 4448).

A NEW VARIABLE STAR OR A NOVA, 97·1910 CYGNI.—In No. 4448 of the *Astronomische Nachrichten* Mr. Hinks records the discovery of what appears to be a new star, or an unrecorded variable, on plates taken by him on August 7, 10, and 12, 1909. The position of the object is R.A. = 19h. 49m. 55·01s., dec. = $+36° 46' 57·4''$ (1900), and the approximate magnitudes on the dates named were 10·4, 10·2, and 10·5 respectively.

Plates taken on August 17, 19, and 26 show no trace of an object in this position, although those of August 17 and 26 show stars down to magnitude 12·5; nor could the star be found visually on September 19 and 26, when it should have been visible if brighter than mag. 13·0.

Mr. Hinks publishes a chart of the region around the object, and asks for any available information as to its appearance on photographs which may have been taken elsewhere.

NEW VARIABLE STARS IN HARVARD MAP, NO. 52.—In Circular No. 162 of the Harvard College Observatory Prof. Pickering announces the discovery, by Miss Cannon, of twenty-two new variable stars on No. 52 of the Harvard maps. The region of the plate is 18h. $-60°$, and altogether thirty-five variables were found. Some of the new variables have ranges of three or four magnitudes, one, D.M. $-57°$ 8613, varying from 7·6 to 10·0; this is of the Algol type, and has a spectrum of the fifth class.

ANTHROPOLOGY AT THE BRITISH ASSOCIATION.

THE Anthropological Section at the Sheffield meeting was presided over by Mr. W. Crooke, whose works dealing with the ethnology of India are well known and highly valued by all anthropologists. His address has already appeared in NATURE (September 29) and need not be alluded to here, except to refer to the tribute that was paid to the work of Dr. Tylor, who has so lately resigned his professorship at Oxford, and who presided over the department (as it then was) of anthropology at the last Sheffield meeting, held thirty-one years ago.

A feature of the section's work was the joint discussion with Section L (Education) on the measurement of intelligence in school children, to which Dr. Spearman, Dr. Lipmann, Dr. Myers, and Messrs. Burt, Brown, and Gray contributed. A report of this discussion will be given in the account of the proceedings in Section L.

Beyond this the work of the section ran on the usual lines, the number of archæological papers being again a prominent feature. The section, as usual, had the advantage of hearing reports on their work by members of the British Schools of Archæology at Athens, Rome, and in Egypt, and also from gentlemen who have been excavating and exploring in the British Isles.

In the following summary the papers are broadly grouped together under the various subjects with which they dealt.

Archaeology.

Mr. T. Ashby described the excavations which have taken place at Caerwent, the site of Venta Silurum. These have consisted of the uncovering of several more houses, and of the excavation of the central insula to the north of the city, which contains the Forum and Basilica. This latter had no apses, and from its S. aisle at each end were entrances into the streets. The Forum was surrounded by an ambulatory and shops. Numerous skeletons were found in another part of the city, but were not contemporary, being obviously of post-Roman date. Closely akin to this paper was Prof. Bosanquet's account of the excavations at Caersws, undertaken by the Liverpool committee for excavation and research in Wales and the Marches.

Mr. H. D. Acland presented a paper on some prehistoric monuments in the Scilly Isles, which consisted of a description of two groups of menhirs. Several of those of one group have a constant orientation differing 4° from a normal bearing. A group of intersecting banks was also described, which have a similar variation as the menhirs.

The excavation of a broch at Cogle, Watten, Caithness, was described by Mr. Alexander Sutherland. The building had been overgrown with vegetation, and five successive layers of ashes and pavement were found. Among the Neolithic remains were several stone pestles, discovered in the lowest stratum; these were of a basalt-like stone and were originally of oval or oblong shape, but had been worn down by constant pounding until some of them had become circular. The broch was 30 feet in diameter.

The Rev. Dr. Irving read a paper on the prehistoric horse, found some little time ago at Bishop's Stortford. Careful comparisons have been made with other skeletons, and the conclusion seems warranted that it represents a late Pleistocene race, which has survived into Neolithic, Bronze, or the Early Iron period, the age of the deposit being

difficult to judge, as stone, bronze, and iron have all been found. The site, however, shows promise of proving to be of some importance, and a committee has been appointed by the association to assist in its examination.

A suggestive paper was contributed by Mr. George Clinch on some unexplored fields in British archæology, in which he directed attention to the amount of destruction of antiquities which is occurring annually, urged the establishment of regular and systematic oversight of great engineering works which involve excavation and removal of soil, and directed attention to certain promising forms of archæological exploration, such as blown sands, peat mosses, marshes, and dried river sites.

The committee appointed to investigate the lake villages in the neighbourhood of Glastonbury reported the results of the work carried out at Meare, on two distinct groups of low circular mounds. The excavations included the examination of three dwellings and trenching with the object of finding the palisading, but although the ground was examined for some 100 feet from the mounds, no such border protection was discovered. The relics found were all of the greatest interest and importance, and show clearly that the Meare people lived under similar physical conditions and civilisation as did their neighbours at Glastonbury.

In what may be termed Mediterranean archæology four papers were presented. Messrs. A. M. Woodward and H. A. Ormerod described a group of prehistoric sites excavated by them in south-west Asia Minor. Nineteen prehistoric mounds were examined, extending from the plains of Elmeli in N.E. Lycia to Lake Kestel in Pisidia. The potsherds found were mainly of a red hand-polished ware, assignable to the Bronze age, but fragments of a black polished ware were also discovered, some of which may possibly be of Neolithic origin. Painted pottery showing affinities to Cappadocian and Early Cypriote Iron age fabrics were also discovered, but this pottery appears to be independent of Ægean influence or importation. The remains of a megalithic rectangular house were found.

A paper on excavations carried out in Thessaly in 1910 was submitted by Messrs. A. J. B. Wace and M. S. Thompson, the sites chosen for the season's work being Tsangli and Rachmani. On the first of these, remains of Neolithic houses were discovered, square in plan with internal buttresses. Celts and vases were found, and also terra-cotta statuettes, of which the male figures, rare in Thessaly, showed markedly phallic characters, while the female were steatopygous.

At Rachmani houses were discovered, and a considerable amount of pottery and a few figurines. A comparison of the two excavations enables the prehistoric age in Thessaly to be divided into four periods:—(1) Neolithic, with red and white painted pottery; (2) Neolithic, with Dhimini and kindred vases; (3) sub-Neolithic, to which period belongs the remarkable encrusted ware; and (4) Chalcolithic, in which period the pottery is unpainted, and the latter part of it is apparently contemporary with Late Minoan II and III.

Dr. T. Ashby, the director of the British School at Rome, described the excavations carried out by him at Hagiar Kim and Mnaidra, Malta, under the auspices of the Maltese Government. The object of the work was to discover whether the excavations carried out many years previously had completely revealed the ground plan and to endeavour to find sufficient pottery to enable the date of the structures to be determined. In both respects the action was justified by results. A large, hitherto unknown, roughly paved area was discovered at both places, and at Mnaidra subsidiary buildings, perhaps devoted to domestic uses, were disclosed. The small objects found, fragments of pottery and flint, corresponded absolutely with those from the hypogeum at Halsaflieni, so that it seems clear that Hagiar Kim and Mnaidra are also of the Neolithic period.

Some cup and ring markings and spirals from the hypogeum at Halsaflieni were described by Dr. Dukinfield Astley. The markings are done in red paint on two of the roofs of the buildings.

Prof. Petrie gave an account of the work carried on by the British School in Egypt at Meydum and Memphis. At the first place the archaic sculptured tombs were removed, owing to the damage they had suffered from native plunderers. Two of these chambers are unique, the colours being inlaid in deep undercut hollows. The burial chamber of the largest tomb was excavated, in which was found a sarcophagus of red granite, the oldest known, dating about fifty years earlier than that in the Great Pyramid. In the course of the work at Meydum quarry marks were found on many of the blocks. As these name the months of quarrying, it makes it possible to fix the shifting months of the Egyptian calendar, as the season of quarrying is closely fixed by the inundation. The result is the fixing of the reign of Sneferu at 3200 or 4700 B.C.

At Memphis work was begun on the temple of Ptah The main result has been the discovery of a large shrine built by Amenhotep III, and a portrait head of King Amasis. Sealings were found on the palace site, while pottery kilns were also carefully explored.

Dr. Seligmann contributed a paper on a Neolithic site in the southern Sudan, at which hammerstones, pygmy implements, and implements of hornstone were found, all on the surface.

A description of the archæological activities in the United States, as carried on by the various universities and public bodies, was given by the well-known American anthropologist, Miss Alice Fletcher, who was appointed a vice-president of the section for the meeting.

Ethnology and Ethnography.

Several papers on general ethnology and ethnography were presented to the section. Mr. E. Torday described the Bu-Shongo of the Congo Free State, a tribe inhabiting the district between the fork of the Kasai and Sankuru rivers. The nation is composed of a number of subtribes all under one paramount chief. The most famous of the chiefs was Shamba Bolongongo, who has become the national hero, and is venerated because he was a man of peace and a great lawgiver and philosopher. The organisation of government now existing is that remodelled by this chief, although it has become greatly weakened. In theory the king is absolute, but his power is limited by two bodies, somewhat analogous to two houses of parliament. Above all is the king's mother. There is a form of totemism. The people are great wood-carvers, amongst the most interesting products of this art being portrait statues of their kings. Five of these are known and three of these are now in the British Museum, amongst these being that of Shamba Bolongongo himself.

Mr. Mervyn W. H. Beech contributed a paper on the Suk of east Africa. These people, who live to the north of Lake Baringo, are akin to the Nandi, but with a large aboriginal element. This is especially seen in their language, which, although it contains a large percentage of Nandi and a little Turkana, has a considerable amount of what is probably aboriginal. The tribe is divided into totemic and exogamous clans, and the social system resembles the Nandi; but, on the other hand, the dress, ornaments, and dances are like those of the Turkana and differ entirely from those of the Nandi.

Mr. G. W. Grabham read a paper on native pottery methods in the Anglo-Egyptian Sudan. He described the various kinds of pots made, the most interesting, perhaps, being the gobanas, or coffee-pots. Two cup-shaped saucers are made and roughly dove-tailed together; the join is then smoothed down, a handle and spout added, and the whole is then scraped, polished, ornamented, and baked.

Dr. W. H. R. Rivers, in his paper on kava drinking in Melanesia, explained that many facts point to this custom being indigenous and not an importation from Polynesia, or, if introduced, that it has a far greater antiquity than other Melanesian customs to which a Polynesian origin has been ascribed. In the southern New Hebrides the method of preparation resembles the Polynesian, and the name is the same, so that here the practice may have been influenced by the Polynesians; but in the northern New Hebrides, Banks and Torres Islands, the name is indigenous, and the whole ceremonial of making and drinking the infusion differs fundamentally from that of Polynesia. In many cases its use has a clearly religious and social character. The occurrence of the practice in the Fly River region of New Guinea suggests that the distribution of the custom may have been very wide, and that in New Guinea and northern Melanesia kava has been replaced by betel.

In his paper entitled "A Search for the Fatherland of the Polynesians," Mr. A. K. Newman endeavoured to prove, partly by the evidence of place names, that the first home of the Polynesians was in the Ganges Valley.

Two papers of general ethnological interest were contributed by Miss Fletcher and Mr. E. S. Hartland. In the former—a sidelight on exogamy—the author directed attention to the exogamic character of the Omaha social organisation, while in the latter Mr. Hartland discussed the origin of mourning dress, and held that mourning was worn not so much as a disguise, as suggested by Dr. Frazer, but as a means of typifying the union of the dead and as an expression of sorrow and abasement, so as to deprecate the malice of a spirit, naturally annoyed at finding itself disembodied.

It is particularly gratifying to record that the committee appointed at Winnipeg to consider the feasibility of starting an ethnographic survey of Canada reported that, owing to representations made by the council of the Association and by a deputation of the committee and others, which waited upon Sir Wilfrid Laurier, the Dominion Government has included in its estimates the sum of 420*l.* to establish a department of ethnology under the Geological Survey. This most gratifying result may be considered as entirely due to the initiative taken by the Association at the Winnipeg meeting.

Two ethnological papers of great interest were those by Prof. Elliott Smith on the people of Egypt, and by Prof. H. J. Fleure and Mr. T. C. James on the people of Cardiganshire. The latter of these should perhaps be classified under physical anthropology, as the survey was largely an anthropometrical one.

Prof. Elliott Smith began by urging the impossibility of reconstructing the history of man in Egypt unless the work is based on the study of physical characters, as apart from mere measurements, of accurately dated human remains from the three great divisions of the Nile Valley—Lower and Upper Egypt and Lower Nubia. Of the origin of the predynastic Egyptians, all that at present could be safely said was that they showed affinities to both the Mediterranean race and to the Arabs. Although just before the end of the predynastic period some slight change in the character of the population can be seen, it is not until the Third Dynasty that the significance of the change can be fully appreciated. At this date it becomes clear that each of the three divisions of Egypt had its own distinctive population: Lower Nubia, a people identical with the predynastic but tinged with negro; Lower Egypt, the descendants of the predynastic peoples, mixed profoundly with white immigrants, who came in by way of the Delta, while Upper Egypt, though not directly affected by either of these alien stocks, was yet indirectly affected by both, through the intermingling of its people with those of the two other districts.

In the time of the Middle Kingdom this white and Nubian influence became more marked in the Thebaid, and thus the gradual gradation of physical characters, from the black of Nubia to the white of the Levantine population in the north, began to set in, a gradation which has persisted to the present day.

Messrs. Fleure and James pointed out in their paper that the basis of the population of Cardiganshire appears to be the Mediterranean type, that is, a type marked by considerable dolichocephaly, dark hair, slight prognathism, and a stature a little below the average. But as the type becomes fairer these marked characteristics disappear, prognathism ceases to exist, and the head becomes shorter. Amongst this population there is also a fair type, in which the heads become still shorter and the stature higher, while the face becomes opisthognathous.

Physical Anthropology.

In purely physical anthropology two papers only were presented, there being still the marked decline in papers of this nature which has been noticeable during the last five years. It is very much to be regretted that the anatomists and other workers in the field of physical anthropology have ceased from presenting the results of their work to the Association, and it is to be hoped that a turn in the opposite direction will soon set in.

Prof. C. J. Patten described a rare form of divided parietal in the cranium of a chimpanzee. Cases of this kind are extremely rare, and the one under consideration appeared to be an example of complete division of both parietals, each by a horizontal suture, running the entire length of the bones and joining the coronal and lambdoid sutures. The case is of further interest owing to the way in which the upper segment of each bone is again subdivided. Correlated with this condition there is a thinning out of the bones of the cranial vault and a reduction in the size and strength of the zygomatic arch and of many of the processes at the base of the skull.

Dr. W. L. H. Duckworth exhibited a microtome, made by the Cambridge Scientific Instrument Company, which provides a means of preparation of anthropological material possessing great interest. Some of the preparations thus made were mounted as lantern-slides and exhibited; for example, in a section of the leg of an adult man, tissues so distinct in consistency as bone, tendons, and muscles could be seen. Other specimens exhibited were sections of the larynx and tongue.

Finally, the report of the committee to conduct archæological and ethnological researches in Crete contained long reports on Cretan anthropology, by Mr. C. H. Hawes, and physical observations, viz., head form and pigmentation, of Cretan school children, by Dr. Duckworth. Both these reports contained a mass of detailed measurements and observations which it is impossible to summarise. One point may, however, be mentioned. Dr. Duckworth is of opinion that the general physique of Cretan children is frequently, if not always, poor, being markedly inferior to that of British children of the same age.

AGRICULTURE AT THE BRITISH ASSOCIATION.

IN drawing up the programme for the Sheffield meeting the organising committee of the Agricultural Subsection adhered to the lines laid down last year. Certain problems of current interest and importance were discussed at joint meetings so far as possible, and attention was directed particularly to those aspects of the problems on which men of pure science could throw much needed light. There were, therefore, very few general papers, and such as were read were regarded rather as preliminary accounts of work that must come on later for discussion.

The chairman's address has already been printed *in extenso* in these columns (September 8). It dealt with fertility, the eternal and fundamental problem in agriculture, and traced the history of the views that have been held since the early experimenters of the seventeenth century began their work. Fertility depends on several factors, any one of which may at a given time become a limiting factor and determine the growth of the plant. The amount of available mineral food, the supply of water, and the supply of nitrates all enter into the problem. All that science can do as yet is to ascertain the existence of these factors one by one, and bring them successively under control; it is not yet possible to disentangle all the interacting forces the resultant of which is represented by the crop.

Dr. Crowther and Mr. Ruston discussed the impurities of the town atmosphere and their effect on vegetation. Rain water falling within the industrial section of Leeds is highly charged with mineral and tarry matter, and also contains a good deal of acid. The rain of the residential districts is much purer, but still not as pure as country rain. Pot experiments, and observations made in gardens, parks, &c., showed that the effect of the impurity was complex; the stomata of the plants were blocked, especially if they happened to be sunk as in the conifers; the soil also suffered. These actions produced marked results on vegetation; in extreme cases the plants were actually killed, and even those surviving were much affected. The case of grass was examined in some detail because of its technical importance. It was found that the impure rain reduced the yield and the protein-content of the herbage but increased its fibre-content. The feeding value was therefore much diminished.

Prof. Berry followed with an account of the ether extract of the oat kernel. It has long been known in a general way that the ether extract is not all fat, although so labelled as a matter of convenience. Prof. Berry has

examined the extract in detail, and the great value of his work is that he is dealing with definite varieties of oats grown under known conditions. It is understood that the research is being continued, and some interesting conclusions may be looked for.

Mr. A. S. Horne gave an account, illustrated by photographs, of a bacterial disease of potatoes. Not long ago it was supposed that plant diseases were caused by fungi, but cases are steadily accumulating where bacteria are the active agents. Several cases have been worked out at Newcastle, and it was felt that on a future occasion more time will have to be devoted to this important branch of study.

The second day was given up to a discussion of two subjects now coming much into prominence. Sugar-beet growing was dealt with by Mr. Sigmund Stein and Mr. G. L. Courthope, M.P. Later in the day nitrogen fixation was discussed by Mr. Golding and Prof. Bottomley. It has always been known that sugar beet could be grown in England, but the industry never had an opportunity of development by reason of the Continental sugar bounties. The Brussels Convention, however, has so altered the position of affairs that a reasonable prospect of success seems assured; already factories are springing up in different parts of the country, and farmers are contracting to supply the necessary beets. For many years Mr. Stein has advocated beet-sugar production, and in his paper he gave a summary of the various experiments he has made to meet the objections that have from time to time been raised. He claimed that the practical difficulties, both in the field and the factory, are now overcome, and the time is ripe for active development. Mr. Courthope dealt with the financial aspects of the question, and gave a number of carefully prepared statistics showing that the new industry has every probability of success. This paper created a very favourable impression, and the speakers that followed agreed that a good case had been made out. There has, as usual, been a good deal of exaggeration about the possible effect of a new rural industry. If sugar beet is grown, some other crop will have to go out; the gain to the country will therefore be the difference between the new and the old, and not, as is commonly stated, the whole amount that the new crop will bring in. Still, there is no doubt that a new industry and a new market would have a useful steadying effect on agricultural prices.

Nitrogen fixation was the next subject. Prof. Bottomley brought forward the evidence in favour of his proposition that Azotobacter, in conjunction with Pseudomonas, both obtained from the root tubercles of Cycas, will "fix" more nitrogen than either alone. He further argues that this mixed culture will grow in soils and "fix" nitrogen to form compounds readily transformable into plant food. Some discussion arose as to the interpretation of the results; the quantities involved are small, and the experimental errors known to be considerable. The great difficulty arises, however, in the absence of a satisfactory standard by which one experiment may be compared with another.

Mr. Golding dealt with his subject in a more general way, his researches having been directed to the whole question of nitrogen fixation in the root nodules of leguminous plants. This fixation is brought about by bacteria which invade the root hair as infection threads, pass through a rod-shaped stage, and finally assume the bacteroid (Y) form. Mr. Golding is steadily overcoming the difficulties of working with the organism in artificial media, and is succeeding in making it pass through the changes that it undergoes in the plant. During the period of active nitrogen assimilation an alkaline substance is formed; after a time, if the products are not removed, assimilation stops, the alkali disappears, and the medium becomes acid. Dr. Russell pointed out that this change from alkaline to acid reaction indicated that the organisms were now utilising the nitrogenous base already formed, and therefore setting the acid free, a change known to go on in other cases.

On Monday, September 5, a joint meeting was held with the Zoological Section to discuss the effect of partial sterilisation of soils. Dr. Russell read a paper which he and Dr. Hutchinson had prepared, giving an account of the work they have been doing at Rothamsted during the past three years. There is a notable increase in productiveness when a soil is heated or treated with volatile antiseptics like toluene. This was traced to an increase in bacterial activity, which, in turn, was shown to be the result of removing some factor that had in the original soil limited bacterial activity. By drawing up a systematic plan of experiment it was possible to find what processes would, and what would not, put the injurious factor out of action, and so the authors had arrived at a list of properties the factor possessed. According to their results it appears to be a living organism larger than bacteria, but developing more slowly, killed at or below 50° or by prolonged drought. It might actively destroy bacteria, or, on the other hand, it might form a protoplasmic layer round the soil particles containing organic matter, and thus keep off and starve the bacteria. The zoologists present made some very useful suggestions. Dr. Shipley recommended sewage-farm soils as the best place to start hunting for the organism. Dr. Ashworth suggested that the amœbæ or amœboid organisms of the soil might be the culprits, and considered that methods of investigation like those used by Musgrave and Clegg or by Noc might with advantage be tried. Mr. T. J. Evans, on the other hand, thought that the results indicated a mycetozoan plasmodium, while Mr. J. J. Lister urged that mycetozoa would require vegetable matter, which, however, they would have in the soil.

Mr. K. J. J. Mackenzie followed with an account of the "points" prized by the breeder of high-class stock, and gave the results of measurements he had made to find out how far the "points" really are correlated with the characters they are supposed to indicate. So far as he has gone—he is pursuing the problem further—the correlation is very slight, and it can only be inferred that the breeder arrives at his eminently successful results rather by an intuitive process than by any use of his "points." The question is of great economic importance, because England is, and seems likely to remain, the stud-farm of the world.

A joint meeting with the Geological Section followed, at which soil surveys were discussed. A paper by Mr. Hall and Dr. Russell was read, dealing with the objects and methods of agricultural soil surveys. The ordinary drift map is not sufficient, although it makes an admirable starting point. It is necessary to classify the soils further, to study them in their relation to the local agriculture, and to ascertain the effect of manures, of rainfall, topographical position, &c. Illustrations were given to show that a soil may be sufficiently described from the agricultural point of view when its mechanical analysis, and its positions on the geological, orographical, and rainfall maps are known. Mr. L. F. Newman gave a preliminary account of his survey of the drift soils of Norfolk, which seems to indicate a fairly regular distribution of the various types of soil. Mr. C. T. Gimingham described the "teart" land of Somerset, on which animals "scour" badly. This condition is confined to one formation, the lower lias, and disappears when even the most superficial covering of alluvium occurs. A large acreage is affected. Evidence is adduced that the cause is to be sought in the physical state of the soil; if this is so, it should be capable of remedy. It is much to be hoped that the field trials which Mr. Gimingham has drawn up to test this view will be carried out.

The last day opened with a paper by Mr. Hall on the cost of a day's horse labour on the farm. This fundamental problem of agricultural economics has been but little investigated, and Mr. Hall's estimate of 2*s.* 7*d.* per day must be regarded as the most complete we have at present. Another economic paper followed, by Mr. Turnor, on costs in the Danish system of dairy farming. The data were gathered during a tour of Denmark, and represent a good deal of study of the subject. Mr. Turner is shortly bringing out a book in which the results of his investigations will be more fully dealt with.

The rest of the day was devoted to a discussion jointly with the Economic Section of the errors of agricultural experiments. Prof. Wood opened the subject with three papers prepared in conjunction with Messrs. Stratton and Bruce. From the results it appears that many of the feeding trials carried out in the country are of very doubtful value. Agriculturalists have usually neglected the experimental error; in few, if any, of the numerous county council experiments, for instance, is it ever taken into account. Prof. Wood's papers, along with one by Mr. Hall and Dr. Russell on field trials, have emphasised the import-

ance of the matter, and steps are being taken to distribute these papers among agricultural experimenters.

A paper by Mr. Collins on the errors of milk analysis concluded the session.

The position of agriculture at the British Association is not yet settled. Whatever the council decide to do, it is hoped they will continue to give a separate organisation to agriculture, and thus afford to workers in agricultural science an opportunity—the only opportunity for some of them—of meeting their fellow workers in pure science and discussing their problems. It is necessary to get help from several sides and not simply from one, as from the chemical or the botanical, which seems to be the theory of a sub-section. However, whether lawfully or not (it appears to have been unlawfully) the organising committee has hitherto enjoyed the fullest liberty, and has succeeded in arranging a series of meetings that have proved extremely helpful to agricultural investigators, and promise to play no small part in the encouragement of agricultural research.

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

IN addition to the presidential address, which has appeared already in NATURE, there were a number of interesting papers communicated to the section. Physiology was unique in that it was the only section that met at the University; and thus, although somewhat isolated from the other sections, enjoyed the advantage of the laboratories for demonstrations.

There were two joint meetings, one with Chemistry (Section B) and Botany (Section K) on the biochemistry of respiration, and the other with Education (Section L) on speech; the latter will be reviewed in the proceedings of the section of Educational Science. In addition, Dr. Leonard Hill, F.R.S., gave an interesting address on the prevention of caisson disease. The individual papers will be reviewed, as much as possible, so as to form groups in a logical sequence.

The discussion on respiration, held in the meeting-room of Section K, was opened by Dr. F. F. Blackman, F.R.S., who dealt with the subject under three headings.

(1) The series of chemical reaction which take place during oxidation. He took glucose as a typical example, of which the final products are carbon dioxide and water, but the intermediate steps are difficult to follow. Buchner's zymase produces alcohol and carbon dioxide from glucose, but it has been shown that alcohol cannot be oxidised by plants, and hence it must be surmised that some other substance, before the breakdown has reached the alcohol stage, is what is actually oxidised. There are probably many of these fugitive compounds, amongst which may occur lactic acid and di-hydroxy acetone. An alkaline sugar solution, as the result of exposure to sunlight, gives rise to substances which are easily oxidised. He then dealt briefly with oxidases, peroxide formation, and Palladin's hypothesis of respiratory chromogens, which are oxidised by oxidases to peroxides, and then pass on the oxygen to oxidisable material.

(2) The physical chemistry of the processes involved in oxidation. Influence of temperature on velocity of reaction (usually shows a coefficient of about 2·5 within the limits of temperature at which living processes can occur); the uniformity of the respiratory quotient (O_2/CO_2) at different temperatures and the effect of the concentration of the reacting substances were discussed. He illustrated these points by referring to his experiments with green leaves and potatoes (starchy and rich in sugar). The output of carbon dioxide by green leaves is reduced to zero by exposure to sunlight. The potatoes rich in sugar show a greater rate of oxidation than the starchy ones. The conclusion is arrived at that there is a minimal tissue respiration and an excess of respiration depending on the supply of respirable material.

The influence of accelerators, paralysators, and other substances was mentioned.

(3) Special influences of colloidal nature of cell protoplasm. Oxidation and reduction take place side by side, and death of the cell mixes up these two processes. Alterations of permeability of protoplasmic septa may account for changes in physiological oxidation processes.

Dr. H. M. Vernon referred to Dakin's work on oxidation of fatty acids and amino-acids by hydrogen peroxide and traces of ferrous salts. If zymase is allowed to act upon glucose for a short time, then the solution is boiled and oxidase and hydrogen peroxide are added, there is almost complete oxidation to carbon dioxide and water; this suggests that oxidases may act in living cells if organic peroxides can replace hydrogen peroxide. His own experiments on survival respiration (kidney) point to the presence of oxidases, and that certain poisons act by combining with aldehyde or similar groups. Some substances act especially on the "high-grade" process (formation of carbon dioxide) and not so much on the "low-grade" process (oxygen absorption), and thus the respiratory quotient is lowered. In relation to minimal protoplasmic and excess respiration, he directed attention to the fact that minced tissues show at first a greater output of carbon dioxide than when intact, but that the respiration soon falls to a much lower level.

Dr. E. F. Armstrong pointed out that in many respects oxidases differed from the other kinds of enzymes (they are heat stable and not specific in action), that their action can be imitated by colloidal suspensions of inorganic matter, and that traces of inorganic material are usually present in them. There are, however, specific oxidases. He then demonstrated the blackening of laurel leaves by the action of toluol (other chemically inert substances with little affinity for water act similarly), which he ascribed to a general breakdown of the protoplasm with liberation of oxidases.

Mr. D. Thoday spoke about the result of experiments on anæsthetised leaves. Small doses of chloroform cause a temporary increase of oxidation. A large dose causes a diminution in the output of carbon dioxide; with Helianthus and cherry laurel there is a great increase in oxygen intake, which quickly falls off, but with Tropæolum the oxygen intake falls at once. It was suggested that tannins oxidise first, and as there are no tannins in Tropæolum there is no initial increase of oxidation. Probably the result is brought about by an increase of permeability.

Prof. H. E. Armstrong, F.R.S., referred to Leathes' work on the splitting of fats at intermediate points in the carbon chain, and to the formation of peroxides by manganese and iron with hydroxy-acids. Oxidation may take place by decomposing water with liberation of hydrogen; in plants the hydrogen may be used to reduce carbon dioxide to formaldehyde. The leaf surfaces show a permeability similar to that found by Adrian Brown for barley grains.

Prof. Waller and Dr. Reynolds Green spoke, and Dr. Blackman replied.

Dr. Leonard Hill, F.R.S., reviewed the work done in relation to the prevention of compressed air illness. Whilst exposed to high pressure the body dissolves a larger amount of gas than at ordinary atmospheric pressure, and when the pressure is reduced bubbles of gas may be set free in the blood vessels. The solubility of the gas follows Henry's law; owing to the capacity of the tissues to absorb oxygen it is only the nitrogen that is set free in the vessels. The symptoms depend on the portion of the circulation which is stopped by the nitrogen embolus. Different portions of the body saturate at different rates, but work, by increasing the circulation, increases the rapidity with which the body takes up and gives off nitrogen. By analysis of the gases in urine it can be shown that it takes an appreciable time for the body to get into equilibrium with the pressure of the nitrogen in the atmosphere, or, in other words, the blood does not get into equilibrium with the gas on passing once through the lungs.

The relative merits of uniform decompression and decompression by stages were discussed. Long shifts are better than short, as there are fewer decompressions for the same amount of work, and the danger is due to decompression. When symptoms occur they can be abolished, or the danger minimised by recompression to the original pressure.

He recommended that, during decompression, occasional inhalations of oxygen should be taken (to lower the partial pressure of the nitrogen in the lungs, and thus

hasten the removal of nitrogen from the blood) and that exercise should be taken to increase the circulation, and thus remove the nitrogen from the "slow" parts more quickly.

Prof. F. S. Lee, of Columbia University, read two papers. (*a*) "The Cause of the Treppe." During the course of the staircase the excitability of the muscle increases. Clamping the trachea causes a second treppe. Fröhlich states that the treppe is due to slowing of relaxation, so that the increase in height of contraction is only apparent, as the contraction starts at a higher level; but at one stage of the treppe the contractions are not prolonged, while there is no delayed relaxation during fatigue of mammalian muscle. (*b*) "Summation of Stimuli," with Dr. M. Morse. Repeated subminimal stimuli can cause contraction. Traces of lactic acid, carbon dioxide, and other substances that are formed during fatigue increase the excitability of muscle. Gotschlich finds that muscle becomes acid as the result of repeated subminimal stimuli. Prof. Lee suggested that the treppe and summation of stimuli are both due to traces of fatigue substances.

Prof. C. S. Sherrington and Miss S. C. M. Sowton presented two communications dealing with the constant current as a stimulus of reflex action, and the effect of the intensity of the current on the response to stimulation. The preparation used was the isolated extensor of the knee in decerebrate rigidity. Non-polarisable electrodes were placed on an afferent nerve of the limb. A weak stimulation caused a reflex increase of tonus. This is a nearer approximation to the artificial production of reflex tonus than has hitherto been obtained. Otherwise the result of artificial stimulation is a reflex inhibition, as indeed it is with this stimulus when stronger. A stronger stimulus causes an increase of tone, followed by inhibition. A strong stimulus abolishes the preliminary increase of tone, and only inhibition results. In fact, the results obtained are exactly the same as have long been known for the direct stimulation of the opening muscle of Astacus claw. Stimulation occurs at the make and break of the constant current, and not usually during its passage. With a strength of current which gives a reflex increase of tone, chloroform converts the response to inhibition, and as the chloroform passes off the response to the stimulus again becomes an increase of tone.

Dr. J. Tait: (1) "The Conditions Necessary for Tetanus of the Heart." Refractory period of heart consists of absolute and relative refractory stages. The former lasts during systole, and the latter gradually diminishes from the end of systole. The stronger the stimulus the earlier it can be made effective in the relative refractory period. If the stimuli are sufficiently strong they can be effective at the end of systole, and tetanus results. Very strong stimulation causes electrolysis, which produces a series of contractions that gradually die away. (2) "Neurogenic Origin of Normal Heart Stimulus." Excised frog's heart-beat sometimes shows grouped beats (Luciana groups). These are probably due to waves of excitation from rhythm-producing centre. The tendency to grouped beats is increased by lack of oxygen, and the rate and rhythm correspond to that seen in tracings of Cheyne-Stokes respiration; hence the normal heart-beat is regulated by some mechanism similar to that which is affected in Cheyne-Stokes respiration. A constant stimulus with waves of increasing and diminishing strength would, as the strength increased, become effective earlier in the relative refractory period, and hence the increase of rate of beat.

Dr. H. M. Vernon reported the results of some experiments on the combination of poisons with the contractile substance of cardiac muscle. He used the tortoise heart, and perfused it with the various solutions. Alcohol, chloroform, and ether all cause effects proportional to their concentration, and recovery occurs on removal of the drug by fresh saline. Hydrocyanic acid and sodium fluoride cause a marked effect in small concentrations, but the action does not increase much when the strength of solution is increased. Recovery is not good, and is less with the stronger strengths. On removal of the sodium fluoride the heart-beats show remarkable oscillations of amplitude. The vitality of the heart is always permanently injured, as a second test with the same strength causes a greater effect than at first. The season and condition of the heart cause minor differences in the result.

Prof. C. S. Minot, of Harvard University, gave his views on the morphology and nomenclature of blood corpuscles. Present nomenclature not satisfactory. Both red and white cells originate from the primitive wandering cells (mesamœboid). Leucocyte = white cell, and can be subdivided into lymphocyte (young leucocyte), finely granular, and coarsely granular. Erythrocyte = red cell, and they can be subdivided into ichthyoid stage (cells like those in fish with a nucleus showing chromatin network), sauroid stage (like birds and reptiles, nucleus homogeneous, usually called normoblast), and plastid (non-nucleated or mammalian type).

Prof. C. S. Sherrington, F.R.S., Dr. E. E. Laslett, and Miss F. Tozer communicated the results of some experiments indicating the existence of afferent nerves in the eye muscles. The sensory nerve-endings maintain a primitive reptilian type; many "brush" and "creeper" endings are found in the region where muscle and tendon join. No muscle-spindles are found, but a clasping form of ending, which is probably a simple form of spindle. The eye muscles have a greater nerve supply than any other muscles. By cutting the nerves and examining the muscles after the nerves had degenerated it was proved that the third, fourth, and sixth cranial nerves contain sensory fibres in addition to the motor fibres, which are usually stated to be the only kind present. These nerves are therefore afferent-efferent nerves. No sensory fibres to the extrinsic eye muscles were traceable from the first division of the fifth nerve. There are a few small medullated nerve-fibres which do not degenerate after section of all of the foregoing nerves; these are apparently vasomotor, and come from the otic ganglion.

Dr. Dawson Turner and Dr. T. George recorded the results of the X-rays in therapeutic doses on the growing brains of rabbits. The development of the exposed side of the brain was slower than the other side. Fatty degeneration of the irides and loss of weight occurred during treatment. The subject is important, as X-rays are frequently used on children in the treatment of ringworm.

Prof. A. B. Macallum, F.R.S., read three papers: "The Origin of the Inorganic Composition of the Blood Plasma," "The Inorganic Composition of the Blood Plasma in the Frog after a Long Period of Inanition," and "The Microchemistry of the Spermatic Elements in Vertebrates."

The first two deal with the relative amounts of the inorganic salts in the blood. The ratios of these to each other are fairly constant throughout, and agree with the relative amounts of the same substances in sea-water; but there are some variations, and the total amounts of inorganic material are different in the different species. He explains the distribution of the salts as reflecting the composition of the ocean at that epoch when the blood plasma of the species in question ceased to respond to changes in the salts of the ocean. The vertebrate kidney is the factor that maintains the ancestral composition of the blood.

The third paper dealt with the distribution of iron and potassium in the spermatic elements. The iron in the nucleus diminishes through the series spermatogonia, spermatocyst, spermatid, and is absent from the head of the sperm itself. Mode of elimination masked. Potassium abundant in spermatic elements, gathered at anterior and posterior ends in frog, and only in posterior region and in bands in man. No potassium in the head itself.

Prof. W. H. Thompson spoke on the nutritive value of beef extract. Dogs were fed on a constant amount of dog biscuit until their weight was steady. The addition of beef extract caused an increase of weight ten or twenty times as great as the amount of extract added. Boiled egg-white was not nearly so efficacious. Nitrogen apparently not retained, and when beef extract was discontinued the dogs returned to their former weight. The increase in weight is not due to retained water, but to an increased digestion and absorption of the dog biscuits, as the nitrogen and total amount of fæces were diminished.

The reports of research committees were, as usual, of a technical nature. They often briefly referred to papers which have been published elsewhere, and thus are not suited for detailed description here. Arising out of the report on anæsthetics was a brief discussion on the advisability of legislation to improve the training of those who are destined to administer anæsthetics, and to prohibit unqualified persons from administering them. Prof. A. D. Waller, F.R.S., in connection with the report on electromotive phenomena in plants, read a paper describing the method used to estimate hydrocyanic acid in plants and animals, with an application of the method to medicolegal purposes. The committee on ductless glands report on a considerable number of researches, the results of some of which have already appeared. The reports on body metabolism in cancer and on mental and muscular fatigue each contain instructive and suggestive material.

Some interesting photomicrographs of muscle fibres were shown by Dr. Murray Dobie, who published his first paper on the structure of muscle in 1848.

Prof. J. S. Macdonald exhibited the respiration calorimeter on two separate occasions. The heat production of a resting man was compared with that of a man riding a bicycle.

A SUGGESTED RESEARCH FUND FOR TROPICAL DISEASES.

THE *Times* of November 2 publishes the subjoined appeal which Lord Northcote has addressed to the Lord Mayor in favour of the allocation of a part of the fund raised for a London memorial to the late King to the establishment of an Edward VII. Tropical Research Fund. The proposal has received the support of leading representatives of many national interests, including Lord Crewe, Secretary of State for the Colonies, Lord Elgin, Lord Kitchener, and Mr. Joseph Chamberlain.

Letter to the Lord Mayor.

My Lord Mayor,—Having noted that you are taking steps to form a representative Mansion House Committee for the purpose of raising a fund to provide a memorial of the late King in London, and that you are receiving numerous suggestions as to the form which that memorial should take, we desire respectfully to offer the following suggestion for your earnest consideration.

(2) The late King, in his beneficent activity for the welfare of his people, was inspired by two ideals—peace for mankind and war on disease. His work in the former of these directions has been recognised by the world at large; it is in following his lead in the second that we think that a fitting tribute to his memory will be found.

(3) Only recently, but now unmistakably, has the nation become alive to the vital importance of its tropical possessions. Their development proceeds apace, but at a heavy cost in human life and vital energy. Rarely does a mail arrive which does not bring sorrow into at least one home in these islands.

(4) For generations mankind have been willing to accept in a fatalistic spirit the death toll levied upon them by what was vaguely known as "the climate." Now this is no longer so. Thanks to the devoted labours of scientific men—among whom our own countrymen hold an honoured place—we know in many instances what the enemy is and how it is to be met.

(5) Those who are not conversant with the subject will be surprised and almost startled to hear the effect on human life of measures taken as the result of such investigations. We give three illustrations, drawn from the history of three of the greatest scourges of the tropics:—

(*a*) Malaria.—In Klang and Port Swettenham, two towns within the protected Federated Malay States, remedial measures were commenced in 1901. The deaths from malaria were in 1901 368 and in 1905 45. In the surrounding districts, where no measures were taken, the deaths for these years were respectively 266 and 351. In Hong Kong remedial measures were commenced in 1901. In that year the admissions to hospital were 1294 and the deaths 132. In 1905 the admissions were 419 and the deaths 54. In 1904 the United States took over the administration of the zone of the Panama Canal; the deaths from malaria, which in 1906 were 821, had sunk in 1908 to 282.

(*b*) Yellow Fever.—In the city of Havana 35,952 persons perished of yellow fever between 1853 and 1900. The United States Government commenced remedial measures in 1900, and in 1907 only one case of yellow fever was reported.

(*c*) During the last three years steps have been taken in Uganda to stamp out sleeping sickness, an epidemic which in one district alone had destroyed some 200,000 people out of a total population of 300,000. In 1907 the deaths in the kingdom of Uganda numbered less than 4000, and in 1908 they fell to 1700.

(6) It will be seen that, tested by results, these figures are full of promise, and prove conclusively that the measures taken have proceeded on sound lines.

(7) It will naturally be asked: How have these results been achieved? The answer, so far as this country is concerned, is by private effort in close cooperation with the Government. Leaving out of account the Liverpool School of Tropical Medicine, which has been generously endowed by the citizens of that city, the bodies which are responsible for sustained and organised effort are the Royal Society, the London School of Tropical Medicine, the Sleeping Sickness Bureau, and the African Entomological Research Committee, all of which are associated with the metropolis. The first of these enjoys no direct Government support, and has carried out its work by a committee which includes some of the most eminent names in the profession of tropical medicine, who have given their services freely and gratuitously. The London School of Tropical Medicine at the Albert Dock, which owes its establishment, in part, to private generosity, receives an annual grant from Government of 1300*l*. The Sleeping Sickness Bureau is supported entirely by Government, the annual cost being some 1200*l*. The African Entomological Research Committee has recently been established to investigate the insects which convey disease to men, animals, and plants in the tropics, and includes among its members the best authorities on the subject. It receives a Government grant of 2000*l*. a year, and it is working in close cooperation with the Natural History Museum. In addition to the foregoing grants, a grant of 750*l*. a year is made to the University of London for the purpose of assisting work which has an important bearing on tropical medicine.

(8) The three cases which we have mentioned above are those in which the most striking results of scientific research have hitherto been obtained, but it is hardly necessary to say that they cover only a small portion of the field. Notwithstanding the rapid advance of knowledge in tropical diseases, there are many as yet unknown or imperfectly understood. The causation of blackwater fever, of dengue, of beri-beri, and of many other diseases still calls for investigation.

(9) We submit to your committee that no more appropriate memorial to our late Sovereign could be proposed than the establishment of a fund to carry on and extend the work of research into tropical disease. We further submit that it is eminently appropriate that London, the metropolis of the Empire, should take the lead in a movement for giving the full benefit of British administration to these outlying portions of the King's dominion, which have contributed in no small measure to her prosperity in the past, and will, by their development, give still ampler ground for her gratitude in the future.

(10) There can be no class in this great city to which the scheme will not appeal. To the rulers, the missionaries, the philanthropists, and all those who concern themselves with the welfare of the millions of coloured races whom Providence has committed to our charge it will appear of transcendent importance. To those whose kith and kin have gone out to bear their part in the work of civilising our tropical possessions, in whatever station of life, it will appeal no less strongly. To the man of business, in whose profit and loss account the dangers to the health of his employés figure so largely, our proposal will need no further recommendation. The ultimate aim is the creation of a Tropical Britain whose peoples are freed from the scourge of sickness, and where

the work of civilisation moves forward without the present toll of life and health. It is impossible to overestimate the results, both moral and material, that such a consummation would entail.

(11) We suggest that a fund should be established—to be known as the Edward VII. Tropical Research Fund—the interest of which should be devoted to furthering the objects which we have indicated. We think that the cause which we have at heart will be best served by not attempting to define too strictly the way in which this revenue should be appropriated. It is probable that in the first instance, and to a large extent, it would be most usefully expended in subsidising the efforts of the institutions to which we have already referred, being administered by a body whose composition will be a guarantee to the subscribers that their moneys are being wisely and economically applied.

We are, my Lord Mayor, yours faithfully,

NORTHCOTE.

25 St. James's Place, S.W., October 27.

MODERN SCIENTIFIC RESEARCH.[1]

RESEARCH is a word much used in newspapers and in public discussions nowadays, but few people outside purely scientific circles have any clear idea as to its meaning. Of course, the dictionary tells us that it signifies a searching again or a careful search, but the question then arises, What is the object of the search and are there any rules to guide?

The object may be purely visionary, as was the object of the early chemists and alchemists, whose operations, extending through the dark centuries of the Middle Ages, left behind practically nothing but an extensive, though barren, literature, the witness of the credulity and ignorance of those times. The lesson to be derived from the whole of this strange history is one which needs to be continually revived and set in the new light of modern discovery and invention. The lesson is simply that until men began to observe and interrogate nature for the sake of learning her ways, and without concentrating their attention on the expectation of useful applications of such knowledge, little or no progress was made. In other words, until a sufficient foundation of pure science has been successfully laid there can be no applied science. Real progress comes from the pursuit of knowledge for its own sake.

I say, again, this truth needs to be continually reiterated, for there are still too many people who think that the true and only business of science is to find out useful things, and who regard all the rest as waste of time.

The first qualification for research is undoubtedly that kind of inspired curiosity which can never be eradicated, and which we know by many examples is not defeated by such obstacles as poverty, or ill-health, or pressure of other necessary occupations. Another qualification is some knowledge of the subject chosen for inquiry. As to this latter qualification considerable differences of opinion have been expressed. Priestley, whose statue stands near the Town Hall in Birmingham, and many of the chemists of his time, had very little preparatory instruction, but some of them made discoveries of fundamental importance. Priestley seems to have been of opinion that very little preparation is necessary, and the discoveries which might result from experiment were regarded by him as largely the result of chance and to be compared with the game which might fall to the gun of a sportsman in a new country, and whether fur or feather cannot be foretold. But though this might have been partly true in Priestley's time, it is certainly very far from true in our day, when the accumulation of knowledge, however imperfect, is still immense.

Every great discovery is the culmination of a long series of discoveries each of which is a necessary step, and ignorance of these preliminaries stands in the way of advance.

It will be worth while to examine a few cases by way of illustration. No better example can be found than the establishment of the great principle in chemistry commonly called the periodic law. According to this law, the properties of the elements and of their compounds stand in a definite relation to their atomic weights.

Modern views concerning the constitution of gases affords another illustration of the way in which the possession of one kind of knowledge leads to more knowledge. Forty years ago students were led to believe that there were two kinds of gases, namely, on the one hand, those which by the action of cold, or pressure, or both together could be liquefied, and on the other hand some half a dozen which could not be reduced to the liquid state. This was attributed to some fundamental difference of constitution in the two kinds of gas.

If we look for an example drawn from the domain of biology there is the doctrine of evolution, now universally accepted, which is based on the results of the patient collection of facts by Darwin and Wallace. But those facts would perhaps not have been collected, and they would certainly have been without meaning, but for the results of the study of comparative anatomy by previous generations of naturalists and palæontologists, as well as the recognition of the great doctrine of uniformitarianism in geology proclaimed and established by Lyell.

The examples cited will not appeal to the practical man in the same way as some instance taken from a direct application of science to business or practical affairs. If it is really necessary to consider a case of that sort, nothing could be better than the *dynamo*, which, as a transformer of energy, comes into prominent daily use in connection with lighting, traction, and as a general motive agent. The detailed history of the evolution of the dynamo would be a long story, and on this occasion it is only necessary to point out one or two facts. For the fundamental principles involved we must go back to Benjamin Franklin, and Galvani and Volta, all in the eighteenth century, and later to 1831, when Faraday discovered the generation of induced currents by moving a conductor in a magnetic field. But doubtless the experiments made by Franklin with the kite, by Galvani on frogs' legs, and by Volta and Faraday with bits of wire, were by the people of their day looked upon with a mixture of amusement and contempt, just as some people even at the present time are apt to exclaim, "Who cares whether there is oxygen in the sun?"

It is obvious, then, that whatever may have been possible in Priestley's time, the wholly uninstructed person cannot expect to meet with much success in these days in the discovery of new facts; and although the exceptional man may acquire in a very short time some knowledge of a special part of a subject, he is in perpetual danger of falling into great mistakes. It seems to me that a considerable amount of knowledge, skill, and experience is an indispensable equipment for anyone who enters seriously into the practice of scientific research. Not that these qualifications alone serve as inducements to such a career, for it would be quite easy to point to examples of learned people who have added nothing new to the branch of knowledge with which they are best acquainted. This is not necessarily due to indolence, nor to ignorance of the methods of research, but is merely the result of peculiarity of temperament which lacks that divine curiosity which alone supplies the stimulus.

I am speaking now only of real scientific research, the inquiry into the secrets of nature, not of the occupation of those who have only practical ends in view.

Looking back over the great principles of natural science, we see that in every case they have been established by the efforts of the amateur, and by amateur I mean all who have undertaken the work for the pure love of it. This includes, not only men of independent position like Cavendish, Lyell, and Darwin, but a large number of men who have held the office of professor or teacher, but who, in this country at any rate, are neither paid to do such work nor required by the conditions of their appointments to undertake it. So far as I know, there is but one institution in this country in which the professors are not required to teach, but only to press forward into the unknown, and that is the Royal Institution in London. But the character which that famous place has assumed during the last hundred years is not that with which it began its career. It was started at the end of the eighteenth century by Count Rumford with purely utilitarian purposes in view, namely, for teaching the

[1] Presidential address delivered to the Vesey Club, Sutton Coldfield, on October 13, by Sir William A. Tilden, F.R.S.

applications of new discoveries in science to the improvement of arts and manufactures and to "facilitating the means of procuring the comforts and conveniences of life"; and while retaining that character and those pretensions it soon came to the verge of collapse. But Davy's lectures and discoveries changed all that, and Faraday's genius consecrated the laboratories for all time to the service of pure science.

Let us review very briefly the great principles on which physical science is based.

First, of course, there are the fundamental principles of the conservation of matter and of energy, the latter finally established on a quantitative basis by Joule in 1843. There is the principle of uniformitarianism introduced into geology by Lyell now extended so as to include, not only the phenomena of this earth, but of the whole cosmos, such extension being mainly due to the use of the spectroscope by Kirchoff and Bunsen, and only a little later by Huggins. The principle embodied in the so-called periodic law of the elements, already referred to, has led to a general belief in the evolution of matter from one primary material, and physicists and chemists are vying with each other in the endeavour to gain evidence as to the details of the process. I need scarcely say that the principle of evolution as applied to living beings is associated indissolubly with the names of Darwin and Wallace.

Notwithstanding the discovery of radium and its allies, and the discoveries by J. J. Thomson as to the disintegration of atoms into corpuscles a thousand or more times smaller, all ordinary chemistry is built up on the conception of atoms introduced by John Dalton just a hundred years ago. The consolidation of this theory has proceeded as a consequence of the discoveries begun in 1872 by Wislicenus, developed by van 't Hoff and Le Bel in 1874, and confirmed by an army of other workers down to the present day. We now not only suppose it probable that atoms are placed within a molecule in definite positions relatively to one another, but in a great many cases their order and arrangement in space can be positively traced.

Suppose all these great laws and principles never to have been discovered—science and its applications would not exist, and the world would have remained in about the same condition as it was in two hundred years ago. Railways, electric light and traction, telegraphs, dyes, explosives, antiseptics, anæsthetics and many other drugs, metals such as sodium, aluminium, magnesium, tantalum, and even modern steel would be unknown.

But these things are merely the results of the recognition, development, and application of the principles already indicated as fundamental, and the immediate corollaries from them. And so it seems that there are two fields for research which are equally necessary to civilisation and progress. In the one the worker watches the operations of nature and puts questions in the form of experiments solely with the desire to find out her ways; in the other attention is given only to those laws, facts, and phenomena which can be made serviceable to man. There is much more public anxiety in regard to the latter, and considering how entirely ignorant are most people about the principles of physical and natural science this is not greatly to be wondered at.

Some people are under the impression that there is an art of scientific discovery which can be communicated from one person to another. That is not my belief. I think the history of scientific discovery shows that each successful pioneer has invented methods for himself, or has at least known how to select from the tools ready to his hand. And with regard to personal qualifications, I do not think it possible to create that combination of mental powers which is called insight. Hence I have very grave doubts about the advisability of spending time and energy in trying to evoke and cultivate the capacity for research in all students in colleges and universities. If this were possible we ought to see greater results in those cases in which it has already been tried. The judicious teacher will, of course, be careful to avoid any appearance of indifference toward ardour and enthusiasm whenever they appear, and he should ever be on the look-out for indications of the kind of capacity which alone repays cultivation, and give it all the encouragement in his power. But the clamour which has of late been raised as to the supposed desirability of extending instruction in the principles and methods of research, down to the very beginners, indicates, to my mind, a lack of judgment on the part of some of the agitators. It seems to be forgotten that in every branch of experimental science, and especially of applied science, there is a great deal to learn, and it is necessary that at the end of his career as a student a young man should be able to *do* things practically and usefully. The theory of music and the laws of harmony are very desirable for the musician, but if he is to be a performer he must devote the greater part of his time to practice on his instrument, whether piano or violin. The case of the student of science is analogous, and if he does not devote a good deal of time to learning the technique of his business he will not be ready for research or anything else. At the present time too many students who can write at length on theoretical questions of a most recondite character, and who boast that they have been engaged in research under eminent teachers, are yet incapable of choosing a subject for themselves or of handling successfully a subject found for them by their teachers or someone else.

With the object of testing the influence exercised by methods of education in science on the development of the faculty of research, I have lately had the curiosity to compare the results indicated by the lists of Doctors of Science of the University of London. Up to 1886 this degree was awarded on the results of a very severe examination. From 1887 onwards it has been obtainable only on the production of a thesis supposed to embody the ideas and the work of the candidate on some subject selected by himself. The examiners are at liberty to impose an examination with the object of assuring themselves of the candidate's knowledge of his subject, but as a matter of practice the examination has been reduced to a mere formality. It was expected that this change of system would be followed by indications of much greater fertility in the fields of research. Owing to the completeness with which chemical literature is indexed, I have been able to make a comparison between the number and character of original papers published by the chemists in these two lists within the ten years following graduation in each case. I have not been able to make so strict a comparison among the physicists owing to the distribution of their work through so many media of publication, but I have been led by a careful survey to the same conclusions as in the case of the chemists. In both classes, the *Examinees* and the *Researchers*, if they may be so distinguished, there are cases in which the doctor, after taking his degree, has done no original work—or at any rate none that was fit for publication—and his name does not appear in the literature of his science. On the other hand both lists contain famous names. I will only mention in passing that the names of Larmor and Lodge appear among the examined. On the whole, I see no indications that the procedure by thesis has had any effect whatever on the character of the graduates. If anything, the list of examined is of somewhat higher quality than the list of graduates by dissertation, for there are nine out of fifty-four who have become Fellows of the Royal Society, while among the others there are only eight out of fifty-nine who can write themselves F.R.S.

In the latter list there may be one or two who may achieve this distinction hereafter, but there are no indications that in the long run the amount and quality of the contributions made to science by the graduates who are supposed to have been trained to research will surpass those of the men who had to face the ordeal of examination.

Does this not seem to justify my original contention that the researcher is born, not a product of educational manufacture, and that his disposition to research will survive all sorts of adverse conditions, including those which are by some people supposed to be inherent in examination?

I feel convinced that most of the great discoveries of the future will be made, as in the past, by the inspired amateur, working usually alone and often on apparently insignificant beginnings, and with results which may not at first receive any attention from the world.

It is, however, necessary in these days to provide for some form of cooperation in research, partly for the reason that the cost of some kinds of investigation is quite beyond the means of most private persons, and partly because of the unfortunate separation which still prevails, chiefly in this country, between science and industry.

First, then, science may justly look for assistance from the State. In England this is given in a grudging way. Parliament allots 4000*l.* to the whole range of the physical and natural sciences. The fund is administered by the Royal Society, and the biggest slices out of it are taken in the form of contributions to the expenses of expeditions. Then there is the National Physical Laboratory, with an expenditure of about 25,000*l.* a year, of which 7000*l.* comes from the Treasury. This seems to be all that comes directly from the national purse; but science is endowed to a certain extent by her friends. This assistance is represented by the equipment of certain schools and colleges by the Guilds of London, and by the small research funds of the Chemical Society and the British Association.

Something more systematic is, however, wanted, and I feel strongly that some of the rather large funds given in the form of scholarships to young students could be more advantageously used if applied to the maintenance of proved investigators to make them independent of the necessity to earn a living by teaching or other professional work. I recognise, however, the difficulties which would attend any such scheme. In the first place, discoveries cannot be made to order. An able, industrious, and conscientious man might work for many years without producing definite results, and a few cases of that kind would destroy or shake public confidence. It would also be necessary to provide incomes large enough to retain the services of the most able men available.

With regard to the application of science to industry, I think our manufacturers have made some progress during the last thirty years. But they still suffer from delusions. The mistake most commonly made arises out of a misapprehension of the methods, powers, and promises of science. It still seems to be too often supposed that a scientific man, called into hurried consultation, can at once overcome a difficulty in a manufacturing process or can devise an improvement which, if adopted, would represent many thousands of pounds profit to someone. If this were so scientific men would be better off than they usually are. What is wanted is a general recognition of the principle that improvements can be expected only as the result of the use of scientific methods, which are simply the methods of reason applied to the materials provided by experience.

What every manufacturer wants is to begin with a scientific education, if not for himself then for his sons or successors, so that those who are at the head of affairs may understand fully the problems before them and in what direction to look for help towards improvement. Failing this he will be dependent on the services of paid assistants, and those services cannot be expected to produce the desired results unless they are paid for on a liberal scale. In this country there has not hitherto been sufficient attraction to draw into the field of technology a due share of the best brains of the nation. The prospect of ultimately reaching a salary of two or three hundred a year at the utmost is not sufficient to induce a young man of first-rate ability to spend several years of his life and a thousand pounds or so of capital in scientific and technical studies; and so the supply of the highest class of scientific assistance is at present far from what it ought to be.

But suppose conditions to improve, a question arises as to the best way of turning such assistance to account.

A suggestion has lately been made that a new society should be formed, to be constituted of trade committees associated with experts in various divisions of science, to carry on experiments confidentially in the interests of the manufacturers who become members of the society. It seems to me that any suggestion is better than none if it results in the closer association of industry and science: but I think this particular proposal would not be found to work in practice. The requirements of different industries are too numerous and complicated to be met by an arrangement so simple, for each committee would find itself occupied with so many different problems that nothing would be accomplished, unless, indeed, the staff were very large. In my judgment each manufacturer must endeavour to work out his own salvation. Moreover, the experience of the German manufacturer, and to some extent also of the American, shows that it can be done effectively. The most famous example known to me is the case of the great Badische colour works at Ludwigshafen, on the Rhine. There is a factory which employs some 5000 men, and which pays, and has always paid, 25 to 30 per cent. or more on its ordinary capital. The great feature of its organisation is to be seen in the direct association of manufacture with research conducted by a staff of highly skilled scientific men.

In England arrangements so complete are unknown, and the number of highly qualified chemists and physicists employed in works is very small. I say nothing about engineers, with whom I am not so well acquainted, but the greater number of the chemists are merely testers doing routine work, and because such men, receiving the wages of a clerk, have not been able to advance the industries with which they are connected, their employers have in too many cases in the past come to the conclusion that science is of no use. In the meantime many things have happened. The neglect of organic chemistry in England forty years ago led to the complete removal of the coal-tar dye industry to Germany, where since that time has sprung up the equally important manufacture of synthetic drugs. The saccharin, the antipyrin, the artificial perfumes consumed in England are not made here, and it now looks as if the fixation of atmospheric nitrogen in the form of nitrate, so important from the agricultural and industrial points of view, was going to be taken possession of by Germany and America acting together, England being left out.

Such things have been said over and over again for the last thirty years or more, and I am not aware that such statements have been shown to be fundamentally mistaken, nor has there ever been any public excuse or explanation of the indifference so commonly displayed.

The link between science and industry must be established by the masters of industry themselves. I do not believe in the efficacy of much of the technical instruction which is talked about, and I fear that much money is being wasted in the attempt to imitate industrial operations in schools and colleges. What is wanted is the highest and most complete kind of instruction in pure science, following a good general education conducted on such lines that the fittest only are passed forward to the university or scientific school. Young people educated in this way form the material which should be utilised by the manufacturer. But he must not expect that a man so prepared is going to earn his salary the first year or two. He has got to learn his business, and must have facilities for doing this, or such talent as he has cannot be turned to account, and this can only be done by taking him into the works. This is a subject on which a great deal might and should be said, but such a discussion is not suited to the present occasion.

In conclusion, I may perhaps be allowed to give a few minutes to a glance at the future—not that I can pretend to descry very much.

We must remember that there is no finality in physical science. The farther we go the wider does the horizon before us become, but every discovery of a new fact or principle gives us a new instrument to help on to higher things. Hence we may reasonably suppose that, wonderful as the past has been, the future will be more wonderful still.

Here I will venture to draw a distinction between invention and discovery, and to invention there is probably no limit. It may be said to consist in making new combinations and permutations in the elements of knowledge already acquired. Among the inventions which have affected the condition of mankind, those which are concerned in locomotion stand first. It may truly be said that life is lengthened, not only by years, but by opportunities, and from this point of view quick travelling, provided by steam and electricity, is a great advantage. It would be unwise to utter any predictions as to what may hereafter be done with big ships and aëroplanes, only the old-fashioned type of nervous system—already shrinking from the increased noise and bustle of the town—shudders at the thought that neither distant valley nor mountain top, from the tropic to the pole, can now be expected to provide an asylum where peace secure from intrusion is to be found.

In Samuel Butler's "Erewhon," a remarkable book

published about forty years ago, a country was pictured in which moral delinquency was treated with sympathy and condolence, while bodily disease of all kinds was held to be a crime, and was punished by fine or imprisonment. I suppose it will take a good many generations to reach that condition of enlightenment, but the time cannot be far off when the propagation of infectious disease will in all civilised countries be abolished.

The habitability of the planet Mars has of late been a subject of much revived discussion. The possibility or probability of the existence of intelligent beings in other parts of the universe, long a subject of debate, is a question of profound interest, but whether communication with them from the earth can ever be established, who can tell?

But as to discovery in physical science, as already said, the horizon widens as we go on; but it seems not improbable that there is a limit set, though as yet very far off, by the capacity of the human intellect. Nature's ways used to be thought simple, but now we know that she is not only mysterious, but complex. However, there is every reason to expect that great strides are possible, even in the immediate future. The sort of problems which remain to be solved are represented by such questions as the following:—What is the cause and nature of gravitation and other sorts of attraction? What is the difference between positive and negative electricity, and what is the relation of electricity to matter? What is the nature of chemical affinity, and is it really electrical? What is the constitution of the elements, and is the transmutation of metals a dream or a physical possibility?

The penetration into final causes seems as we proceed to be further and further out of our reach. The problems of life and mind are, up to the present, inaccessible to man in his present state, and, notwithstanding the hopes and beliefs of some physiologists, it is safe to say that they will remain so for a long time to come, if not always.

And even in regard to common matter and the physical forces, all we know about them is derived from the perception of phenomena through the agency of our senses. Now the senses, sight, hearing, and the rest, have been evolved, not to provide the means of surveying nature, but for the protection and advantage of the body to which they belong. It is possible, therefore, that the human view of phenomena is only a partial and imperfect view; at any rate, the world which is open to the sense perception of a man must be very different from that which is perceived by many animals with their highly specialised senses, such as the scent of the dog, the sight of the carrier pigeon, and perhaps other senses for which we have no name.

"In its ultimate nature," said Herbert Spencer, "matter is as absolutely incomprehensible as Space and Time. Whatever supposition we frame leaves us nothing but a choice between opposite absurdities."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Vice-Chancellor has published to the Senate certain letters from the clerk to the Drapers' Company in which it is announced that the company is prepared to erect a physiological laboratory at Cambridge at a cost not exceeding 22,000*l.*, and to make a further grant of 1000*l.* for the equipment of it upon the following conditions:—(1) that the site be given by the University and approved by the company; (2) that the architect be appointed and the plans approved by the company; (3) that the University undertake adequately to maintain the laboratory when erected, and to provide the salaries of teachers and demonstrators. A Grace will be proposed at the next Congregation gratefully accepting the offer of the Worshipful Company of Drapers, and a syndicate will be appointed to discuss details with the company.

Mr. R. S. Goodchild has been reappointed assistant secretary to the Appointments Board for three years.

GLASGOW.—On Wednesday, October 26, the services of Prof. William Jack, who lately resigned the chair of mathematics in the University of Glasgow after a tenure of thirty years, were suitably recognised at an interesting and largely attended ceremony in the Bute Hall. Sir Henry Craik, M.P. for the University, presented to the Vice-Chancellor, Sir Donald MacAlister, K.C.B., a fine portrait of the professor, painted by Sir James Guthrie, president of the Royal Scottish Academy, which had been subscribed for as a gift to the Court by a large number of colleagues, students, and friends in all parts of the world. In addition, a sum of 300*l.* was provided for the foundation of a William Jack prize, to be awarded at intervals of three or four years to the author of the best dissertation on a mathematical subject submitted during the period in question for the degree of Doctor of Science in the University. A present of plate bearing a commemorative inscription was made at the same time to Prof. Jack. The latter, in an interesting speech of reminiscence, recalled the notable teachers and students with whom he had been associated during the half-century of his connection with Glasgow. His successor, Prof. Gibson, explained the value of the new prize as a stimulus to post-graduate study and research. The Vice-Chancellor, on behalf of the Senate and Court, acknowledged its debt to Prof. Jack, not only for what he had done, and done well, but for what he had been—the trusted friend and guide as well as the instructor of his students, the loyal comrade and peacemaker among his fellow-workers.

MR. S. BRIERLEY, formerly head of the Textile School, Stroud, has been appointed head of the textile department of the Huddersfield Technical College.

DR. J. A. EWING, C.B., F.R.S., Director of Naval Education to the Admiralty, will distribute the prizes at the Merchant Venturers' Technical College, Bristol, on Thursday, December 15.

MR. J. G. STEWART, of Edinburgh, has been appointed by the Essex Education Committee principal of the County Laboratory at Chelmsford. One of the chief duties of the office is to teach scientific farming to the agriculturists of Essex and Herts.

IT is announced in *Science* that Mr. J. D. Rockefeller has recently offered to give to Western Reserve University for further endowment of its medical department the sum of 50,000*l.*, provided 150,000*l.* additional is raised. Toward this 200,000*l.* fund Mr. H. M. Hanna, of Cleveland, has given 50,000*l.* The trustees of the University have indicated their intention to undertake to secure the 100,000*l.* needed to complete the fund. Yale University is to receive the residue of the estate of the late Mr. S. H. Lyman on the death of the testator's brother, with the exception of 5000*l.* The value of the bequest is not known, but the estate is said to be large.

IN NATURE of October 13 a letter appeared from Mr. E. G. Reiss, honorary secretary of the Apprenticeship and Skilled Employment Association, directing attention to the fact that a number of laboratory monitors in secondary schools, who, having reached the age of sixteen years, were no longer eligible for employment by the London County Council, wanted situations. Mr. Reiss writes to say that he has succeeded in placing in various suitable posts all the boys referred to, and points out that a number of girls who have been employed in a similar capacity also want suitable employment. As yet Mr. Reiss has been unable to discover posts for these girls, and would be glad of any suggestions as to openings for them. They are about seventeen years of age. The address of the association is 36 Denison House, 296 Vauxhall Bridge Road, London, S.W.

THE Yarrow Educational Fund of the Institution of Civil Engineers was established to afford assistance to young men who desire to become engineers, who have given proof of their capacity to profit by specialised education and training, but who lack sufficient means to obtain it. Grants varying between 50*l.* and 100*l.* per annum, for a period not exceeding three years, may be made in the discretion of the committee. Applicants for such grants must be of British birth, not more than twenty-one years of age, and must be prepared to qualify for attachment as students of the Institution of Civil Engineers. Several vacancies for scholarships under the fund will occur in March, 1911, and the council of the institution are prepared to receive and consider applications therefor.

Applications should be addressed to the secretary of the Institution of Civil Engineers, Great George Street, Westminster, S.W. Further particulars may be obtained on application to the secretary of the institution.

In the technical schools of this country the library is usually a comparatively unimportant factor in the intellectual work done by the institution in question. This is perhaps partly due to the insistent and ever-growing claims of the laboratories and workshops for apparatus, plant, &c. As a result of this and other causes, the higher work of many technical institutions is seriously hampered by the inadequate provision of scientific and technical literature, works of reference, and the journals of the learned societies. Not only is there a deficiency in the supply of books and journals open to the student, but in some cases the libraries themselves are small, badly lit, noisy, and crowded. This militates against fostering those habits of study which are essential to the progress of the student, especially as in some cases the technical student is unable to secure a quiet working place in his or her own home. The magnificent new library at the Battersea Polytechnic, recently presented by the munificence of Mr. Edwin Tate, and opened on October 21 by the Archbishop of Canterbury, is excellently adapted for study and reading by those attending classes at the polytechnic. The library is 70 feet long and 30 feet wide, and is erected at the south-western corner of the polytechnic, and can be approached both from the main corridor and the present reading-room. At the western end of the library is a wide bay containing a beautiful stained-glass window. The book-cases project at right angles to the wall, forming bays to seat readers, and the gallery runs round three sides of the library. The total book accommodation is 18,000 volumes. The whole of the fittings and panelling are of oak, the floor being of teak. As the building stands close to the road there are double casements, the inner ones being filled with ornamental lead glazing. As regards lighting, there is a separate window to each bay. Speaking generally, the library is planned on lines similar to those on which all modern university libraries are being developed, the books, for instance, being accessible at once to all students. The cataloguing is by card. Efforts are being made to obtain funds in order to increase very largely the technical and scientific portions of the library. It may be mentioned that the library is of considerable use, not only to students of the polytechnic, but also to certain local firms. Some little time ago a circular was sent from the polytechnic to the local chemical firms inviting them to utilise, if they wished, the works of reference and technical journals in the library.

At the meeting of the Education Committee of the London County Council on October 26 the question of the senior scholarships awarded by the council was under discussion. It was eventually decided to increase the number of these scholarships in 1912. Just as it was necessary to increase the number of intermediate scholarships in 1910 when the first batch of junior scholars attained the age of sixteen, so it will be necessary to increase the number of senior scholarships in 1912 when the same candidates reach the age of eighteen. The number of senior scholarships available for competition at present is 50; in 1912 it will be 100. The standard required for the award of these senior county scholarships is, however, not to be lowered in any way. It is estimated that the annual cost of awarding 100 of these scholarships will be 20,000*l*. In the award of senior county scholarships the council has regard, in the first instance, to the past achievements of the candidates and to the reports of the teachers under whom they have worked and of other responsible persons acquainted with the candidates, and such reports must have reference to the character and qualifications of the applicants as well as their scholastic attainments. The scholarships consist of a maintenance grant not exceeding 90*l*. a year. This amount is in each case determined after consideration of the requirements and the financial circumstances of the candidate. Senior county scholarships are, as a rule, tenable for a length of time necessary for a student to take an honours degree in the subject selected, provided that this period is not more than four years When the scholarship has been held for four years the council may, in a limited number of cases, continue the scholarship for a fifth year if satisfied that there are exceptional circumstances which render such further continuance desirable. At present the income of the parents or guardians of a scholarship holder must not exceed 400*l*. a year. A proposal to abolish this limit was referred back to the higher education sub-committee for further consideration.

SOCIETIES AND ACADEMIES.

LONDON.

Institution of Mining and Metallurgy, October 19.—Mr. Edgar Taylor, president, in the chair.—A. J. **Bensusan**: Notes on passagem mine and works.—R. H. **Kendall**: Treatment of refractory low-grade gold ores at the Ouro Preto Gold Mine, Brazil. These two papers, which were discussed conjointly, both deal with the same mines from slightly different points of view, so that one may be taken as the complement of the other. The ore treated is composed of quartz, tourmaline, arsenical and iron pyrites, with some bismuth, and the method of high concentration had to be adopted in view of the difficulties and losses encountered with amalgamation in the presence of arsenical pyrites and bismuth. The ore from the mine passes through grizzlies and rock-breakers to two series of Californian stamps, eighty head in all, and thence over blankets. The material remaining on the blankets is piped to *passadores* for daily concentration, and the concentrate passes through a second *passador* and thence to *bateas*, whence the gold dust is recovered, and the tailings return to the *passador*, and thence with the first *passador* tailings to the concentrates cyanide plant. The pulp from the mortar boxes passes over Frue vanners, whence the rich concentrates pass to the cyanide plant, and the tailings pass through spitzkasten and thence through the sands and slimes cyanide plants respectively. The papers describe the various processes and the plant in considerable detail, and give statistics as to costs, time of operations, and results.—J. Egerton **Wood**: A method of collecting gold from pannings. A short note dealing with a simple means of collecting and preserving gold values obtained in the field until such time as they can be be cupelled in the laboratory.

PARIS.

Academy of Sciences, October 24.—M. Émile Picard in the chair.—A. **Haller**: Two active alcohols and a third ketone contained in spirit from cocoanut oil. The raw material used in the investigation was a bye-product in the purification of cocoanut oil. Apart from acids separated by alkalies, possibly arising from saponification of fatty bodies, methyl-heptyl-ketone, methyl-nonyl-ketone, and methyl-undecyl-ketone were isolated, as well as methyl-heptyl-carbinol and methyl-nonyl-carbinol. The two alcohols were dextrorotatory, the optical inverse of the alcohols isolated from oil of rue.—M. **d'Arsonval**: The second International Congress for the Suppression of Adulteration.—Henri **Douvillé**: How species have varied. As the result of a comparative study of the Lamellibranchs, the author is of opinion that the evolutionary changes have not been continuous, but have occurred in a series of abrupt steps separated by periods of stability.—MM. **Landouzy** and L. **Loederich**: Experimental study of heredity in tuberculosis. The experiments were made on guinea-pigs, dogs, and rabbits, and evidence was obtained of direct placental infection. In the cases where there was no direct infection the mortality was very high from causes other than tuberculosis.—F. **Robin**: The variation of resistance of steels to crushing as a function of the temperature. Relations between the static and dynamic properties of the steels. Data are given for copper, nickel steel, manganese steel, and three steels containing 0·07, 0·384, and 1·8 per cent. of carbon at temperatures ranging between −185° and 1400° C.—Edouard **Salles**: The diffusion of gaseous ions. Experiments were carried out with air, carbon dioxide, nitrogen, and oxygen; measurements were carried out with air at two pressures, 758 mm. and 1028 mm., and with nitrogen at four, 760 mm., 1000 mm., 1120 mm., and 1302 mm.—J. **Duclaux**: Refrigerating mixtures. A lowering of temperature is produced when carbon bisulphide is mixed with acetone. A simple apparatus is described, utilising the regenerative

principle, by means of which a volume of 20 c.c. can be continuously maintained at a temperature 70° below that of the room, with an expenditure of 100 c.c. of carbon bisulphide and 70 c.c. of acetone per hour.—Jean **Villey**: The measurement of very small displacements by means of the electrometer. A condenser formed of two parallel plates and charged to a suitable potential is applied to measure extremely small displacements of one of the plates. Using an electrometer giving a motion of 150 cm. per volt on a scale 350 cm. distant, with a condenser formed of circular plates 6·5 cm. radius and 158 μ apart, a displacement of the spot of 150 cm. on the scale is obtained when the condenser plate, charged to 176 volts, is moved 0·001 mm., or a magnification of 1,500,000. The sensibility exceeds that of the interference methods.—J. **Carvallo**: The electrical purification of liquid sulphur dioxide and its electrical conductivity. Liquid sulphur dioxide, already fairly pure, is further purified by the prolonged passage of a current at a high potential. The limiting values obtained for the conductivity do not follow Ohm's law, but laws which recall those governing the conductivity of gases.—Paul **Nicolardot** and Georges **Chertier**: The nitrous esters of cellulose. In an attempt to find the cause of the differences in the percentage of nitric nitrogen in guncotton when determined by the Schlœsing and Crum methods respectively, the author was led to examine the action of the nitrogen peroxides on cotton in presence of glacial acetic acid. The nitro-products thus obtained appear to contain nitrites, and do not yield their true percentage of nitrogen by the Crum method.—MM. **Magnan** and **Perrilliat**: An acephalous human monster.—Mme. V. **Henri-Cernovodeanu**, MM. Victor **Henri**, and V. **Baroni**: The action of the ultra-violet rays upon the tubercle bacillus and upon tuberculin. After a short exposure to the ultra-violet rays the tubercle bacilli are attenuated; after a more prolonged exposure they are destroyed. Tuberculin, after a very long exposure (five hours), gives no reaction with tuberculous guinea-pigs.—A. **Fernbach** and A. **Lanzenberg**: The action of nitrates in alcoholic fermentation. Nitrates are not prejudicial to the fermentation.—E. **Roubaud**: The influence of the physiological reactions of Glossina in the salivary development, and the virulence of the pathogenic trypanosomes.—Paul **Marchal**: Contribution to the biological study of Chermes.—M. **Fabre-Domergue**: The storage of oysters in filtered water. After remaining for eight days in filtered water oysters do not diminish in weight, and do not appear to be depreciated in any way.—Carl **Störmer**: The situation of the zone of maximum frequency of the aurora borealis according to the corpuscular theory.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 3.

ROYAL SOCIETY, at 4.30.—The Origin of the Hydrochloric Acid in the Gastric Tubules: Miss M. P. Fitzgerald.—(1) Trypanosome Diseases of Domestic Animals in Uganda. II. *Trypanosoma Brucei.* (Plimmer and Bradford); (2) Trypanosome Diseases of Domestic Animals in Uganda. III. *Trypanosoma vivax* (Ziemann): Colonel Sir D. Bruce, C.B., F.R.S., and others.—Further Results of the Experimental Treatment of Trypanosomiasis; being a Progress Report to a Committee of the Royal Society: H. G. Plimmer, F.R.S., Capt. W. B. Fry, and Lieut. H. S. Ranken.—On the Peculiar Morphology of a Trypanosome from a case of Sleeping Sickness and the possibility of its being a new Species: Dr. J. W. Stephens and Dr. H. B. Fantham.—Note upon the Examination of the Tissues of the Central Nervous System, with Negative Results, of a case of Human Trypanosomiasis, which apparently had been cured for years by Atoxyl Injections: Dr. F. W. Mott, F.R.S.—On a remarkable Pharetronid Sponge from Christmas Island: R. Kirkpatrick.

LINNEAN SOCIETY, at 8.—Biscayan Plankton, Part XIII. The Siphonophora: H. B. Bigelow.—Plankton Fishing in Hebridean Seas: Prof. W. A. Herdman, F.R.S.

RÖNTGEN SOCIETY, at 8.15.—Presidential Address: Dr. G. H. Rodman.

MONDAY, NOVEMBER 7.

ARISTOTELIAN SOCIETY, at 8.—Self as Subject and Self as Person: S. Alexander.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A Sixth Journey in Persia: Ancient Parthia, Nishapur, and Turshiz: Major Molesworth Sykes, C.M.G.

SOCIETY OF ENGINEERS, at 7.30.—Public Slaughter Houses: S. M. Dodington.

TUESDAY, NOVEMBER 8.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Recent Advances in, and the Present Status of Gas Lighting: F. W. Goodenough.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The London County Council Holborn to Strand Improvement, and Tramway Subway: G. W. Humphreys.

WEDNESDAY, NOVEMBER 9.

GEOLOGICAL SOCIETY, at 8.—The Rhætic and Contiguous Deposits of West, Mid, and Part of East Somerset: L. Richardson.—Jurassic Plants from the Marske Quarry: Rev. G. J. Lane.

THURSDAY, NOVEMBER 10.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Tidal Observations of the British Antarctic Expedition, 1907: Sir George Darwin, K.C.B., F.R.S.—Conduction of Heat through Rarefied Gases: F. Soddy, F.R.S., and A. J. Berry.—The Chemical Physics involved in the Precipitation of Free Carbon from the Alloys of the Iron Carbon System: W. H. Hatfield.—On the Determination of the Tension of a recently-formed Water surface: N. Bohr.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—The Relation of Mathematics to Experimental Science (Presidential Address): Sir W. D. Niven.—Properties of Logarithmico-exponential Functions: G. H. Hardy.—The Double Six of Lines: G. T. Bennett.—On Semi-integrals and Oscillating Successions of Functions: Dr. W. H. Young.—On the Existence of a Differential Coefficient: Dr. W. H. Young and Mrs. Young.—The Analytical Extension of Riemann's Zeta-function: F. Tavani.—The Geometrical Representation of non-real Points in space of Two and Three Dimensions: T. W. Chaundy.—The Extension of Tauber's Theorem: J. E. Littlewood.—A Note on the Property of being a Differential Coefficient: Dr. W. H. Young.—The Stability of Rotating Shafts: F. B. Pidduck.—A Class of Orthogonal Surfaces: J. E. Campbell.—On Non-integral Orders of Summability of Series and Integrals: J. W. Chapman.—Optical Geometry of Motion: A. A. Robb.—Lineo-linear Transformations, specially in Two Variables: Dr. A. R. Forsyth.—On the Conditions that a Trigonometrical Series should have the Fourier Form: Dr. W. H. Young.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Presentation of Scholarships and Premiums.—Inaugural Address of the President: S. Z. de Ferranti.

FRIDAY, NOVEMBER 11.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.—On the names used by Bolten and Da Costa for genera of Venerdiæ: A. J. Jukes-Browne, F.R.S.—On New Melaniidæ from Goram and Kei Islands, Malay Archipelago: H. B. Preston.—On the Anatomy of the British Species of the Genus Psammobia: H. H. Bloomer.—Note on *Triton tesselatus*: Major A. J. Peile.

PHYSICAL SOCIETY, at 8.—On the supposed Propagation of Equatorial Magnetic Disturbances with Velocities of the Order of 100 miles per second: Dr. Chree, F.R.S.—On Cusped Waves of Light and the Theory of the Rainbow: Prof. W. B. Morton.—Exhibition of a Brightness Photometer: J. S. Dow.

CONTENTS.

THURSDAY, NOVEMBER 10, 1910.

PHYSIOLOGY AS A SPECULATIVE SCIENCE.

Biological Physics, Physic, and Metaphysic. Studies and Essays. By Thomas Logan. Edited by Q. McLennan and P. H. Aitken. Vol i., Biological Physics. Pp. xxx+576. Vol. ii., Physic. Pp. viii+284. Vol iii., Metaphysics. Pp. vi+110. (London: H. K. Lewis, 1910.) Price, 3 vols., 24*s*. net.

IN a prefatory note we read that Dr. Thomas Logan was an Ayrshire man, who received his medical education at Glasgow and Aberdeen, and spent almost half a century on busy practice as a public health officer and general practitioner, first in Scotland, latterly in Yorkshire. He died three years ago, at the age of sixty-nine, leaving behind him the manuscript of the three volumes now published. It is stated that his editors were not permitted to make alterations or excisions of any of the text, which therefore appears in the form the author wished, and is illustrated by a number of cuts borrowed from standard works on anatomy and histology. The first volume is entitled "Biological Physics," the second "Physic," the third "Metaphysics."

Dr. Logan would appear to have been very early impressed with the truth of the aphorism, "Circulatio Circulationum omnia Circulatio," and the great bulk of his volumes is devoted to the repetition and amplification of this text. He possessed a great facility with the pen, and was never at a loss for a word or words to express his meaning. Hence his sentences run to 10, 15, or, in favourable instances, 25 lines or more in length. As a philosopher, he committed himself to unbridled speculation and unchastened teleology, employing the deductive method that has found so little favour since the end of the sixteenth century. Thus, for example, he showed (i., p. 165) that the axon of a nerve-cell must be—and therefore is—

"a compound of at least four tubes circulating fluids and substances of different consistence, and qualities, along its intra-spaces, each circulation differing from the other according to the consistence of its material and the freedom from obstacles to its onward progress, the two inner being necessarily slow, but the two outer necessarily relatively quick."

With every nerve-fibre acting as a four-fold tube, there can be no doubt that circulation might proceed merrily indeed; but anatomical or microscopical evidence either that these fibres are tubes, or that they do serve as circulatory channels. Dr. Logan offered none. He was, also, on purely *a priori* grounds, a firm believer in the importance and activity of the pituitary gland. After describing its position in the skull, he went on to say (i., p. 94):—

"Situated thus, it, the pituitary body, must become the receptacle of a mixture of materials, consisting of cerebro-spinal lymph, endothelial cell debris, neuroglial oozings, and whatever else obtains an entrance into it, which it must of anatomical necessity dispose of, and *this*, we claim, must be *its function*; and surely no mean function, yea, a function second to none in the whole category of glandular functions in its direct bearings on the great problem of life and health."

It may be noted in passing that he offered a solution for one at least of these great problems, by saying what life is (i., p. 445):—

"Life, therefore, is a tripartite, but indissolubly united, transcendental entity, beginning with the vitalisation of the elements of nutrition, culminating in their organic incorporation, and ending with their devitalisation and elimination."

Discussing the pituitary and pineal bodies, he did not agree that they are survivals of once important organs (i., p. 97):—

"*Survivals forsooth!* 'Tis nothing less than an insult to *nature*, and an impeachment of her working and administration of the law of 'evolution,' to manufacture and propagate this story of her prodigality in the use of most valuable cephalic, or brain, space as a museum for the storage of obsolete organisms, and her persistent exhibition of a juvenile affection for the display of some of the works of her 'prentice hand in this, the gallery of her latest, best, and finest productions! These structures, called pituitary and pineal glands respectively, are illustrations of the truth of this exclamation and contention, and, it seems to us, that their more exhaustive study will reveal many facts indicating that they are structures of the greatest functional importance in the regulation of the cerebro-spinal lymph circulation, a circulation of equal importance with the great blood-circulation, and a circulation, in fact, emanating from the blood-circulation, and the last of the *great series* of circulations involved in the *chain of vital processes* called by the names deglutition, digestion, absorption, circulation proper, nutrition, assimilation, secretion, and excretion."

Dr. Logan was no less successful in tracing out the path followed by these pituitary products; speaking of the tongue, he said (i., p. 545):—

"Here, then, we claim to see the theatre of one of the concluding acts of the great cerebro-excretory circulation and the final disposal of the residual pituitary material, which finds its way through the pituitary gland, and which in turn finds its way through the lateral sphenoidal foraminal openings into the tonsillar bodies, and thence into the amorphous and semi-adipose material matrix, in the inter-muscular spaces of the tongue, where it affords that semi-plastic and faintly-fluid material in the discharge of which the epithelial covering and papillary structures of that organ are constantly engaged."

One may doubt whether obscurantism could go further. Enough of Dr. Logan's writing has been quoted to exhibit the surge and flow of verbiage on which he launched his *a priori* theories, and floated his elaborate yet elusive and illusory deductions. Throughout his essays he was content with speculation and assertion, rarely did he come down to the level of simple fact and commonplace proof of his novel views. So little was he in agreement with the modern spirit or methods of scientific investigation that one cannot but see in him a writer fated to live some two or three centuries after his time. His volumes illustrate very clearly the strength and the weakness of the undisciplined scientific imagination, so-called, and show the limitations of the arm-chair man of science to perfection. They should be of no little interest to collectors of the literary curiosities of science.

A. J. J. B.

THE COMPLETE BOTANY-TEACHER.

The Teaching Botanist. A Manual of Information upon Botanical Instruction, including Outlines and Directions for a Synthetic General Course. By Prof. W. F. Ganong. Second edition, revised. Pp. xi+439. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1910.) Price 5*s.* net.

THE first edition of Prof. Ganong's book received a welcome on this side the Atlantic such as is accorded to few elementary botanical works produced in America, and it has proved of the greatest value to many engaged in the teaching of elementary botany, or in training as future teachers of the subject. The second edition, lately published, has been thoroughly revised, and, indeed, re-written almost throughout, besides being considerably enlarged, though the general plan, and, above all, the animating spirit of the book, not to mention the very moderate price, remain unchanged. To all intents and purposes this edition is a new work, and should be in the hands of all botanical teachers, both *in esse* and *in posse*, whether or not they already possess the first edition.

In part i., occupying, roughly, half of the book, the author deals in a practical, yet philosophic and stimulating, manner with the place of the sciences in education and of botany among the sciences, followed by a thoughtful and vigorous discussion of the pertinent question, "What botany is most worth?" and proceeds to the consideration of the training of the good botanical teacher, the methods of good botanical teaching, botanical drawings and descriptions, the equipment of laboratories, and the arrangement of collections. A valuable chapter follows on botanical books and their use, with a bibliography—by no means exclusively American—which, with a few deletions, would serve as the catalogue of an ideal library for any institution in which the subject is taught. One is inclined to wonder when there will be found an author—and publisher—courageous enough to publish a "black list" of undesirable books on botany and nature-study generally; but, after all, this would merely postpone for a time the oblivion into which bad books are bound to sink sooner or later.

As is well known, Prof. Ganong has shown himself, especially in his valuable "Plant Physiology," to be an acute critic of many erroneous facts and ideas, and of faulty methods of experimentation, which are only too common in botanical literature, not only in books of the baser sort, but even in standard and authoritative works. In the present work he ends part i. with a breezy and delightful chapter—only too short—on some common errors prejudicial to good botanical teaching, which will bring some discomfort to conscientious teachers, while pointing out to them the better way. Such teachers will, however, be to some extent consoled by the author's candid confession that he, too, has occasionally perpetuated, and even originated, ideas and phrases which are "unfortunate if not erroneous." This chapter is certainly deserving of most careful study by all teaching botanists.

In part ii. Prof. Ganong outlines a general course in elementary botany—not a mere skeleton or series of headings, but a thoroughly practical, fairly detailed, and altogether excellent syllabus of instructions for the carrying out of a very full year's work in the morphology and physiology of plants. It would be difficult to devise a better guide to the elements of botany for those who may go no farther with the subject, or a more suitable first-year course for those who intend to proceed to more advanced work in botany. This admirable and wisely designed course of instruction may be warmly commended, not only to teachers of botany, but to those who are responsible for the drafting of examination syllabuses in the subject in this country.

F. C.

CLIMATIC CONDITIONS AND ORGANIC EVOLUTION.

Die klimatischen Verhältnisse der geologischen Vorzeit vom Praecambrium an bis zur Jetztzeit und ihr Einfluss auf die Entwickelung der Haupttypen des Tier- und Pflanzenreiches. By Dr. Emil Carthaus. Pp. v+256. (Berlin: R. Friedländer und Sohn, 1910.) Price 8 marks.

THIS treatise commences with a consideration of the views of different authors upon the early evolution of the earth. Of the rocks in the earth's crust, Olivine rock (Dunite) is considered by the author to be the most primitive, its formation having taken place before the condensation of the water-vapour contained in the very earliest atmosphere. The gneisses, however, were formed after such condensation had occurred. The beginnings of organic life were present in the original atmosphere of water-vapour, but the author doubts the view of Arrhenius that the early spores could have reached the earth from other heavenly bodies. The period between the Upper Cambrian and Purbeckian was one of little rain, the existence of salt deposits in the early formations at various places widely separated from one another, and the complete absence of real freshwater calcareous deposits prior to the Jurassic being cited as evidence in support of that view. In this connection the interesting questions are propounded: Why have no remains older than the fauna of late Tertiary or diluvial times been found in the caves of Devonian, Carboniferous, Triassic, and Jurassic limestones? Why did cave formation thus probably begin first in Tertiary times?

The occurrence of forests of Rhizophora (Dicotyledons) in the sea of the Malay Archipelago is instanced as a reason against the assumption of the necessarily freshwater origin of the Ferns, Sigillaria, Lepidodendron, Equisetites, Conifers, and Cycads of the older geological formations. Great stress is laid upon the difference in the movements of the sea-water as affecting the forms of life at different times. The increase of these movements in later geological periods tended to destroy the brachiopods, the bilateral symmetry of the Tetracoralla gave way to the radial symmetry of the Hexacoralla, while the later Echinoidea, as compared with the earlier, underwent

changes in the number and arrangement of plates; the increasing complication of the ammonite sutures is explained on the same ground. It is pointed out that the multiplication in number of the sinupalliate Lamellibranchiata in Cretaceous time and their further acceleration in company with the Heterodont forms in the Tertiary period correspond with the incoming and continuance of freshwater conditions. In recent times certain Lamellibranch species in the Black Sea and Caspian Sea have wandered into brackish and fresh water, and as a result there is an increase in length of the siphon, a gaping of the shell, and the formation of a mantle-sinus.

The work has been written in the seclusion of an Indian hotel without the immediate advantages of close contact with the scientific world and its literature. This explains to a great extent the semi-popular nature of the book, and accounts, perhaps, for the omission of a bibliography other than rare and general references in the text. A division into chapters and the inclusion of a more extensive index would have been a decided improvement. Although controversial in many of its statements, the contribution has the undoubted merit of arousing interest and thought. The author appears to be a strong believer in the inheritance of acquired characteristics, and is not inclined to the assumption of an indwelling tendency towards perfection in forms of life; the followers of Cope, von Baer, Naegeli, and von Eimer would, therefore, find much material for debate. The statement that land or fresh-water animals and plants older than of Tertiary age are not found in the earth clefts of primary and secondary formations is certainly erroneous. For instance, the teeth of Microlestes found by Charles Moore and submitted to Owen in 1858 came from a Rhaetic breccia filling a fissure in the mountain Limestone, near Frome, Somersetshire.

IVOR THOMAS.

COMMERCIAL ORGANIC ANALYSIS.

Allen's Commercial Organic Analysis. Edited by Prof. H. Leffmann and W. A. Davis. Vol. II., Fixed Oils, Fats and Waxes, Soap, Glycerol, Cholesterols, &c. Fourth edition, entirely rewritten. Pp. x+520. (London: J. and A. Churchill, 1910.) Price 21s. net.

MOST analysts are aware that a fourth edition of Allen's well-known work is in course of preparation. Two of the eight volumes composing the edition have now appeared, and a notice of Vol. I. will be found in NATURE of June 16 last. Two more are announced for publication this year, and the remaining four are promised without undue delay. The plan of having both an American and an English editor has been adopted, and articles are contributed by writers from each side of the Atlantic. This seems a sensible arrangement, as with comparatively little modification the book is made to serve the needs of chemists in both countries.

The volume now under review is much extended and improved as compared with its predecessor of the last edition. Mr. C. A. Mitchell is responsible for the opening section describing the general properties of the fixed oils and fats, as well as the common processes of analysis, whilst the special characters of the individual products, and the particular methods of examining them, are discussed by Mr. L. Archbutt. Having regard to the scope of the book, both sections appear to be very well done. As much trustworthy information as could well be given in the space allotted will be found in these two sections, and no point of importance calling for adverse remark has been noticed by the present writer in looking through a number of representative pages. Perhaps the articles on arachis oil, olive oil, and the beeswax group may be singled out as good examples of compressed essentials. Sometimes, indeed, the compression is a trifle too marked. Many references, however, are given to original papers, so that fuller details can often be obtained.

Certain products, including butter, soap, and glycerol, are each given a special section. Messrs. Revis and Bolton have taken charge of the chapter on butter fat. They have studied their subject well, and, among other things, have grasped a fact which seems to have puzzled some experts on butter analysis—namely, that the addition of lard to butter may produce a distinct (apparent) increase of the "Polenske figure," which might be taken by the unwary as indicating the presence of cocoanut oil. One or two small errors have crept in; thus the Zeiss values in the first table on p. 290 are wrongly given as being taken at 40° C. instead of 45°, and there are two misprints in the second table on the same page. A favourable opinion, based upon the authors' own experiments, is expressed in reference to Lallemant's "barium saponification" method of examining butter fat. How far the commendation is deserved cannot be judged from the particulars given. For example, granted that the method detects cocoanut oil in butter, it may yet be that the detection could be made just as certainly and much more readily by older processes. The really difficult problem is the recognition of lard or beef-fat when present in butter, and it is in the promise of this that the chief importance of Lallemant's process lies. It will be interesting to see how it stands the test of experience when applied, on a sufficiently extended scale, to genuine butter having Reichert-Wollny values in the region of 23 and 24.

Of Prof. Leffmann's chapter on soaps and the other special contributions it must suffice to note that they contain all that an analyst will generally require to know on the subjects. They help to make the volume a distinct improvement upon the former editions.

C. S.

THE SEVEN LAMPS OF BIOLOGY.

Das System der Biologie in Forschung und Lehre. Eine historisch-kritische Studie. By Dr. Phil. S. Tschulok, Zürich. Pp. x+409. (Jena: Gustav Fischer, 1910.) Price 9 marks.

THE author discusses at great length some of the attempts that have been made to define the scope of biology, and to indicate the logical sub-divisions of the science. Starting with early workers like Ray,

he works on to A. P. De Candolle and Schleiden (of whose importance he is very appreciative), and thence to Haeckel and Spencer, Karl Pearson, and Burckhardt. This laborious historical survey, which must have cost the author much time and trouble, is interesting to those who care for such questions, but it seems to us to be robbed of some of its value by being overloaded and by a lack of perspective. Dr. Tschulok quotes classifications of the different departments of biology from a large number of text-books, some of which are rather humdrum performances, while others are by men who left a deep mark on the science, but had neither any particular interest in mapping out its subdivisions, nor any special aptitude for so doing.

To illustrate, a man like Burckhardt was a good zoologist—too early lost to science—but he was also a philosopher. He went the length of thinking about the classification of the sciences, about the relation of biology to other disciplines, about methodology, and so on, his writings sometimes reminding us of those of Prof. Patrick Geddes in this country. Naturally, therefore, we are glad to have from Dr. Tschulok an exposition of Burckhardt's views, and we are especially grateful for the unearthing of an essay on the history of biological "Systematiks," well-buried "an einem ziemlich versteckten Orte." But what we regret is the space that is given to what are really incompetent classifications. The author wearies us with citations from manuals of botany, which start with commonplace mappings out of the science, sometimes beginning with a weird word like "Glossology," and ending up with "Fossil Botany." The last is a careless usage, which in an interesting irony sometimes justifies itself. Our regret that the author has been at such pains to expose the nakedness of the land is heightened when we find that he has missed most of the few really illuminating British contributions to the subject of his book. We may refer, for instance, to well-known encyclopædia articles by Prof. Patrick Geddes and Sir E. Ray Lankester.

The author divides biology into Biotaxis and Biophysik. The first has to do with the establishment of conceptual relations, the second with the establishment of real relations—causal and teleological. Classification, for instance, is "biotactic"; physiological analysis is "biophysical." He contrasts his dual division with others, *e.g.*, with morphology and physiology (which is a "scholasticism," he says), or with biostatics and biodynamics, which expresses a different idea. But does Dr. Tschulok mean more than this, that we have in biology, as elsewhere, to discover the orderliness of sequences and to sum this up in conceptual formulæ?

The author's chief contribution is a scheme of the subdivisions of biology. His idea is that there are seven kinds of inquiry which are individually indispensable and collectively exhaustive. These are: taxonomy, morphology, physiology, œcology, chorology, chronology, and genetics. This appears to us to illustrate most of the vices of classification, such as overlapping, cross-division, and inequality of values. It appears to us, for instance, that taxonomy and morphology are inseparably bound together; that œcology, as Semper said, is part of physiology; that chorology is not an independent division of the science; and so on. It must be noted, however, that Dr. Tschulok defends his seven-fold classification with enthusiasm and learning. J. A. T.

A MONOGRAPH OF THE PETRELS.

A Monograph of the Petrels (Order Tubinares). By F. Du Cane Godman, F.R.S. With hand-coloured plates by J. G. Keulemans. Part iv., pp. 233–296; part v., pp. 297–381+lv. (London: Witherby and Co.) Price 15*l.* 15*s.*, bound in full morocco.

THE fourth and fifth parts of the "Monograph of the Petrels," completing this beautiful and valuable work, have been received, and the whole work can now be had, bound in full morocco, price fifteen guineas. It contains 436 pages printed on rag paper, and over one hundred hand-coloured plates by Keulemans, our best ornithological artist. In every respect this beautiful volume has been produced in the best possible style. Nor is the letterpress any less excellent. The work was projected, if not actually begun, by the late O. Salvin, who wrote the "Tubinares" for the British Museum catalogue of birds, and the author has endeavoured to carry out the work on the lines laid down by Salvin, taking the catalogue as his guide. The final part contains a masterly introduction to the order Tubinares, a systematic list of species, a classification and key to the genera and species, and an essay by Mr. Pycraft on the systematic position of the petrels.

Petrels apparently belong to an ancient race of birds, as their remains have been found in a fossil state in various parts of the world, mostly in superficial deposits, one species, however, being known from the Red Crag of Norfolk. In external appearance the families of petrels differ in an extraordinary manner, and the species vary in size from the tiny storm petrel to the wandering albatross. Notwithstanding their wide differences, petrels may at once be distinguished from all other birds by their prominent tubular nostrils and by their bills, which consist of several horny pieces separated by deep grooves. They are dispersed throughout the oceans of the world, penetrating to the ice barrier at both Poles, though they are more numerous in the southern than in the northern hemispheres. They are oceanic wanderers, and, unless storm-driven, seldom, if ever, come to land except for the purpose of breeding.

The two parts now before us comprise the rest of the genus Œstrelata, and the genera Pagodroma (the snowy or ice petrel) Bulweria, Macronectes (the "stinker or Nelly" of the sailors), Fulmarus, Daption (the well-known "Cape Pigeon"), Halobæna, and Prion, completing the family Puffinidæ; the family Pelecanoididæ comprising one curious genus; and the family Diomedeidæ (the albatrosses), comprising the genera Diomedea, Thalassogeron, and Phœbetria. Certainly the most curious and perhaps the most interesting of all these are the strange little

diving petrels peculiar to the southern seas, and absurdly resembling the little auk of the northern seas both in appearance and habit—diving, fishing, and flying—although widely differing in structure. Darwin wrote of one of them:—

"No one seeing the bird for the first time, thus diving like a grebe, and flying in a straight line, by the rapid movements of its short wings, like an auk, would believe that it was a member of the family of petrels, the greater number of which are eminently pelagic in their habits, do not dive, and whose flight is usually most graceful and continuous."

Since the completion of Salvin's catalogue the present monograph has derived much benefit from the considerable additions to the national collection made through the several expeditions sent to the Antarctic regions, among which may be mentioned the voyages of the *Discovery*, the *Southern Cross*, the *Scotia*; and from the cruises of the *Valhalla*; as well as from the expedition sent to the Hawaiian Islands by the Hon. Walter Rothschild; these together have considerably increased our knowledge of the distribution of the petrels. A full index brings this important volume to a close.

OUR BOOK SHELF.

Eugenics, the Science of Human Improvement by Better Breeding. By C. B. Davenport. Pp. 35. (New York: Holt and Co., 1910.) Price 50 cents net.

THIS useful little book consists of two parts. The first is an account of the principles which determine whether a given marriage will produce fit or unfit offspring, the second contains suggestions for future eugenic research. In the somewhat limited class of characters and diseases for which definite Mendelian laws of inheritance have already been made out, it is possible to predict with an approach to certainty the proportion of the children which will or will not be affected. Thus the malformation of the fingers known as brachydactyly is a Mendelian dominant. "An abnormal person married to a normal will beget 100 per cent., or 50 per cent. abnormal, according to circumstances, and such a marriage is unfit; but two parents who, though derived from brachydactyl strains," are themselves normal, "will have only normal children . . . such a union is entirely fit."

Deaf-mutism may be due to any one of a variety of defects, but in different individuals of the same family the chance is large that it is due to the same defect. Such defects are often recessives, and may appear in the offspring of normal parents of deaf-mute stocks. Intermarriage between two such parents, especially of cousins, is "unfit." Again, too, imbecile parents, whether related or not, produce only imbecile offspring, a fact which should impress those responsible for the long delay in embodying in legislation the recommendations of the Royal Commission on the Care and Control of the Feeble-Minded.

In concluding his suggestions for future inquiry, Mr. Davenport rightly points out the contrast between the difficulty of raising funds for such scientific inquiries, and the ease with which money is obtained for charitable and humanitarian action which often proves to have been ill-judged.

"One cannot fail to wonder that, where tens of millions have been given to bolster up the weak and alleviate the suffering of the sick, no important means have been provided to enable us to learn how the stream of weak and susceptible protoplasm may be checked." W. C. D. W.

The Book of the Dry Fly. By G. A. B. Dewar. New edition. Pp. xxvii+277. (London: A. and C. Black, 1910.) Price 7s. 6d. net.

THE second edition of Mr. Dewar's "Book of the Dry Fly" follows the first after an interval of thirteen years. It is to be regretted that this second edition is, in reality, little more than a reprint of the first; the art of dry-fly fishing has been developed, and knowledge of the natural history of the trout and of the aquatic creatures upon which it feeds has advanced during these years, and it is a little deceptive to find that references to "last year" in a book with 1910 on the title-page refer to 1896. The deception may even be turned to confusion by the addition of a footnote modifying or contradicting the statements made in the text.

However much we may regret that the book has not undergone a more complete revision, we may still be glad to find that a second edition has been published. Mr. Dewar is a student of nature, as well as a fisherman, and he writes with obvious enthusiasm and interest of various chalk and limestone streams and their surroundings. He deals well with the elements of dry-fly fishing, and appears to touch on most points likely to interest a student of that art.

There are some matters in which we find Mr. Dewar hard to follow, such as his discussion of the modern higher education of trout, but as a rule his explanations are lucid and his opinions clearly expressed. The grayling is, perhaps, treated with rather scant courtesy in the text, although the footnotes show signs of a change of view. A singular misuse of the term "dropper" in chapter ii. is obviously the result of an oversight, and this should be corrected in any future edition.

An attractive feature of the present edition of Mr. Dewar's book is the series of excellent reproductions of water-colour sketches of typical chalk and limestone streams; these should assist the fisherman who does not know the waters of Hampshire or other southern and Midland counties to appreciate the conditions which have brought dry-fly fishing into being far more easily than any mere description in words.

Last, but not least, there is a good index.

Die Entwicklung des menschlichen Geistes. By Max Verworn. Pp. iv+52. (Jena: Gustav Fischer, 1910.) Price 1 mark.

THIS is a lecture by the well-known professor of physiology in the University of Bonn, and is a kind of popular survey of human development. After dealing with the fact that "the development history of the individual form is a short recapitulation of its race development" (Fritz Müller) and with the elaboration of this by Haeckel, Dr. Verworn goes on to emphasise the importance of child-study with relation to pedagogics. A eulogy of Charles Darwin follows, and a curious and interesting table of supposed psychological development from the Eolithic to the present time.

The British Empire in Pictures. A Geographical Reading Book. By H. Clive Barnard. Pp. 64 (London: A. and C. Black, 1910.) Price 1s. 6d.

THE thirty-two excellent illustrations in colour which form the distinguishing characteristic of this book will serve excellently to predispose young pupils in favour of the study of geography. As a supplement to the more serious work of the class-room, the book should prove useful, and it should not be difficult to get children to read the book as a leisure-hour undertaking.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Origin of Dun Horses.

IN discussing the colours and stripes of horses in "Animals and Plants under Domestication," Mr. Darwin says:—"I have endeavoured, but with poor success, to discover whether duns, which are so much more oftener striped than other coloured horses, are ever produced from the crossing of two horses, neither of which are duns. . . . One case, however, has fallen under my own observation of a foal from a black mare by a bay horse, which when fully grown was a dark yellow-dun and had a narrow but a plain spinal stripe."[1]

In a recent number (October 15) of the *Veterinary Record* Mr. J. B. Robertson gives the following instances of reversion to dun from the last eleven and first four volumes of the General Stud Book:—

(1) Bay-dun filly (1907), by Ash (chestnut), out of Unexpected (bay).

(2) Dun filly, Sarah Curran (1892), by Robert Emmett (bay or brown), out of Cellulites (black).

(3) Dun colt (1897), by Sir Frederick (bay), out of Lobelia (bay or brown).

(4) Light dun filly (1886), by Lord Gough (bay), out of Danseuse (brown).

(5) Dun or chestnut filly, Sancta (1884), by Exminster (bay), out of Halloween (chestnut).

(6) Dun filly (1763), by Young Cade (bay), out of Miss Thigh (grey).

(7) Dun colt (1730), by King George II.'s one-eyed grey Arabian, out of Young Kitty Burdett (bay).

(8) Dun filly (1829), by Lottery (brown), out of Octavia (bay).

Mr. Robertson also mentions (1) that a half-bred yellow-dun filly was obtained out of a liver-chestnut Welsh cob by a bay thoroughbred with a dorsal band—this filly "during early foalhood was profusely striped on the face, neck, and quarters"; and (2) that of 45 duns given in the tables included in his paper, 39 cannot be traced to an original dun ancestor. They sprang from the union of Silverlocks (chestnut) and the Godolphin Arabian (brown), "and hence afford incontrovertible evidence that a gametic line of duns—which in this case extended to four generations—may spring from parents neither of which are dun."

The University, Edinburgh. J. C. EWART.

Markings of Mars.

I HAVE recently returned by way of Tasmania from a series of visits to the chief observatories in the United States, which included a month's stay at the Lowell Observatory during the past opposition of Mars. This visit was made with the express object of testing by my own observation the reality of the data on which Dr. Lowell has based his speculations.

I find on my return that so much scepticism has been raised by the observations and arguments of M. Antoniadi and others that a record of my own experience may be of some value.

When I first looked at Mars at Flagstaff (September 27, 1909) I saw with great difficulty three streaks, presumably canals. The seeing was bad, and the general faintness of the planet's markings at that time is admitted by all. I continued to observe Mars on every possible night (which was nearly every night) until October 25, and as my eye became accustomed to the work I saw more and more. The canals were seen repeatedly better—this with the 24-inch refractor generally stopped down to about 18 inches. I found that with more than 20 inches the air was nearly always too unsteady, and with less than 15 inches too much separating power was lost. The canals were seen best with a power of 390 diameters.

Clearer they became each night until, on October 25, the seeing being the best I ever experienced, the canals came out with amazing clearness and steadiness, sharp and clean, like telegraph wires against the sky, the oases also being exquisitely defined. Whereas on previous nights the canals could be held only by short glimpses of perhaps half a second at a time, they were now steadily visible for three or four seconds together, when a short flicker would sweep over them; during the lucid intervals the limb also of the planet was perfectly steady, as I have never seen it before or since. Of the objective existence of these markings in the image at the focus of the telescope there could be no manner of doubt, and Lowell's representations of them are nearer the actual appearance than any I have seen, though even in his drawings the lines seem hardly fine enough. The effect produced on my mind by this remarkable definition, which lasted for upwards of one and a half hours (from about 8.30 until after 10 p.m.), was staggering and ineffaceable. Soon after ten the definition went to pieces.

It may be relevant to mention that a few evenings previously I had obtained a fair and convincing view of the canals with the 40-inch reflector (full aperture and a power of about 700), when they had appeared hazy and broader, but the image had been very unsteady, and only obtained in very short flashes; but nothing that I had hitherto seen had prepared me for the astonishing steadiness and *fineness* of the details visible on this superb night.

There is in my mind no sort of doubt that the revelation of this night was due both to the perfection of the instrument (which its maker long ago pronounced to be the best that the firm of Alvan Clark ever turned out) and the atmospheric conditions which are found at Flagstaff. With respect to these I would mention, as pointing to the freedom from water vapour, that I have seen the thermometer fall from more than 70° F. at 3 p.m. to below the freezing point at 3 a.m. without a trace of hoar-frost, and the general clearness of the air was such that I could see Uranus with the naked eye within 5° of the horizon, and could nearly every night count nine stars in the Pleiades and separate ϵ and 5 Lyræ.

The telescope also afforded on other nights ample evidence of the extraordinary clearness of the air. On many occasions both satellites of Mars, when not very near the limb, could be seen, without screening the planet, with 18 inches of aperture; and on one occasion with this aperture I picked up one of them unawares while looking for canals with *a yellow screen*. (N.B.—The importance of colour screens in rendering the canals visible does not seem to be sufficiently appreciated.)

In the face of all this positive evidence, and in the absence of any evidence that the observing conditions at Meudon, just outside Paris, ever approach these best conditions at Flagstaff, I find it impossible myself to attach any serious weight to the ingenious and plausible contentions of M. Antoniadi, which seem to have been much too hastily accepted in this country.

As to the deductions which Dr. Lowell has drawn from his observations I have nothing to say except that the startlingly artificial and geometrical appearance of the markings did *force* itself upon me.

JAMES H. WORTHINGTON.

Wycombe Court, High Wycombe, October 31.

November Meteors.

THE moon is full about the time when the Leonids become due in the present year, but that is no reason why these meteors should elude observation, for the Sickle has furnished some notable displays of shooting stars. With the moon in opposition in mid-November, as, for instance, in 1799 and 1867, though the coming apparition cannot be expected to vie as regards brilliancy with either of these historic events, yet in its way it may not prove unimportant nor be allowed to pass unobserved. Besides the Leonid epoch, there are also some other meteoric events that occur in November, of which the following particulars have been computed by the writer:—

Epoch, November 11, 9h. (G.M.T.), approximately second order of magnitude. Principal maximum,

[1] "Animals and Plants under Domestication," vol. i., p. 62. (1872.)

November 12, 5h. 45m.; secondary maximum, November 12, 9h.

Leonid epoch, November 17, 21h., twenty-eighth order of magnitude. Principal maximum, November 16, 13h. 45m.; secondary maxima, November 16, 13h. 20m. and 15h. 30m.

Epoch, November 19, 9h., eighth order of magnitude. Principal maximum, November 20, 15h. 15m.; secondary maxima, November 20, 6h. 30m. and 16h. 30m.

Epoch, November 19, 9h. 30m., fifth order of magnitude. Principal maximum, November 20, 14h. 30m.; secondary maxima, November 19, 20h. 30m., and November 21, 0h. 30m.

Epoch, November 23, 22h., approximately second order of magnitude. Principal maximum, November 21, 20h. 30m.; secondary maximum, November 22, 1h.

Epoch, November 28, 6h., approximately second order of magnitude. Principal maximum, November 30, 14h. 30m.; secondary maxima, November 30, 2h. 30m. and 11h. 30m.

It may be seen from the foregoing that there are four periods during the last three weeks of November that will probably be characterised by an unusual degree of meteoric activity, viz. November 12, 16, 20–21, and 30. The circumstance that the moon will be eclipsed in the night of November 16 may favour and stimulate Leonid observations, but the former phenomenon will perhaps have nearly ended before the latter may put in an appearance.

November 7. JOHN R. HENRY.

Early Burial Customs in Egypt.

IT is suggested in Prof. Elliot Smith's letter (October 27, p. 529) that the burial customs in other countries influenced our observation of the burials in Egypt. On the contrary, the occasional practice of dismemberment in Egypt was a surprise to myself and to others; it is only gradually that the evidence for the wide distribution of such customs elsewhere has been brought forward as a parallel.

In place of all workers in Egypt finding "precisely the same state of affairs," many entire differences of custom are found in other material facts besides dismemberment, as thirty years' experience has proved.

The first principle for the archæologist to realise in Egypt is the great diversity of thought and custom which prevailed. With four totally incompatible beliefs about the future life, shown by diverse funeral customs throughout the history, it is quite natural that diversity should occur in the treatment of the body in the earlier ages. When the long-promised publication of Dr. Reisner on prehistoric Egypt is accessible, we shall be in a position to define some more localities where certain customs ruled. Discussion of these local variations before the fresh facts are published is premature.

W. M. FLINDERS PETRIE.

STRIPPED of all irrelevant considerations, the question at issue resolves itself into this, "Is there any real evidence to prove, or even to suggest, that the ancient Egyptians ever mutilated the bodies of their dead?"

In reply, I maintain that there is no evidence whatsoever capable of being twisted into the semblance of support to Prof. Flinders Petrie's contention.

Of all the multitudes of so-called "dissected burials" recorded by him, there is only one (see "Deshasheh," 1898) which carries conviction to those familiar with Egyptian conditions as a genuine case of secondary burial. Prof. Flinders Petrie says he has found two more cases this year. That may well be so. We found more than a score of such cases in Nubia.

But they are not evidence of deliberate mutilation of the body. They are all of them instances of some unintentional damage to the corpse—either by unskilled embalmers or by accident.

In reference to Prof. Flinders Petrie's closing remarks, I may state that by the time this letter is printed there will be published in Cairo Dr. Reisner's report (vol. i.) on the Archæological Survey of Nubia, containing his observations on prehistoric Egypt and Nubia.

G. ELLIOT SMITH.

Simulium and Pellagra.

THE interesting discovery by Dr. Louis Sambon that pellagra is due to a protozoal parasite conveyed by flies of the genus Simulium (NATURE, October 27) is, we may presume, merely the prelude to an energetic campaign of extermination directed against the insect.

It is well that medical men and sanitary officials should realise at the outset of such a campaign that the destruction of Simulium flies in any given area is an infinitely harder task than the destruction of mosquitoes. The larvæ of Simulium live in rapid streams, attached to submerged rocks and stones, and it is difficult to see how these streams can be drained dry if they are numerous in any particular district. Even if it were practicable to cover the surface of these streams with a film of oil, such a procedure would have no effect on the Simulium larvæ, for, unlike mosquito larvæ, the little creatures derive the oxygen necessary for their existence from the water bathing the gills situated at the anterior end of their bodies. In other words, the Simulium larva cannot be suffocated as can the mosquito larva.

Finally, it may be noted that the species of Simulium are very small flies, consequently to exclude them from houses wire gauze or muslin screens of extremely fine mesh must be employed. Such screens are bound to interfere seriously with the circulation of air in a house, and in a warm climate the discomfort entailed will be almost intolerable. R. SHELFORD.

Hope Department, Oxford University Museum.

The Cocos-Keeling Atoll.

DURING a very short visit to these islands some years ago I was taken across the lagoon in a light canoe, and when wading to land, about a quarter of a mile distant, over the rough surface of fresh coral branches, I suddenly crashed downwards for about 2 feet into a mass of rotten coral which spread over an irregular area some 20 or 30 yards across. I did not investigate this further, as a shark's fin appeared above the water off shore, but Mr. Ross informed me that a good deal of the coral in the lagoon had been "killed" at various times by sulphurous exhalations from below, and had become black and rotten in consequence. Mr. Ross (the owner of the island group) supposed that the wide and deep well-like holes and broad irregular patches of varying depth in the lagoon were due to this cause, which he compared to the sulphurous steam constantly roaring from the crater of the Gedeh and other mountains in Java.

If this comparison be correct, as it doubtless is, the Cocos ring is around the submerged summit of a volcanic cone which has not quite lost its solfataric activity. I have never seen it suggested that such poisonous exhalations coming into the still water confined within the atoll ring might account for the slower growth of the coral, and the deepening of the lagoon by the degradation of the coral branches where the polyps had been suddenly poisoned. It is, however, possible that some such influence may cooperate to prevent the coral flourishing as rapidly as it does outside the ring in the boisterous wash of the fresher waves that are constantly stirred by the trades.

I have not yet read Mr. Wood-Jones's book, but it was the decided opinion of Mr. Ross, founded upon boat navigation, that the lagoon was shallowing, because, as he thought, the submerged summit was slowly rising. If this be so something more than slower growth is necessary to account for the continued existence of the lagoon, since, however slow the growth, it must ultimately in a rising area bring the summit up at least to water-level; but if there is this kind of active degradation, neither slow upheaval nor slower growth could prevail against such rapid destruction, and a comparatively deep atoll with irregular bottom contours would result.

Waterstock, Oxon, October 31. E. C. SPICER.

IT would be ungenerous, after the frank admissions of inaccuracy on the part of the reviewer (NATURE, October 27), to criticise the substance of his review in any more detail; but it is necessary to make some reply to his assertions concerning the development of atolls.

From the general trend of his first article (NATURE, October 6) I gathered that the reviewer was an advocate of the "solution" theory of Sir John Murray, and by carefully reading his second contribution (October 27) I have not entirely dispelled this impression. Yet he says, "I do not regard the lagoon in an atoll, which was formed, as Darwin suggested, by subsidence, as covering a reef at all."

This would seem to suggest a belief in Darwin's theory, and, if it is the case that the reviewer upholds this theory (as well as the opposed one of "solution"), it may be well to point out that I too would not regard the lagoon of an atoll, formed by subsidence, as covering a reef. I should not have imagined it probable that anyone would so regard a lagoon were it formed in such a manner. The essential difference between such a view and the one that I have attempted to uphold is that I do not regard the lagoon as being formed by subsidence at all; but I do look on the lagoon as being a "slightly submerged reef" having a raised rim upon which islets are developed. Does the reviewer genuinely regard the lagoon as being formed by subsidence? If he does, why does he also plead the opposed theory of solution, and appeal to the *elevated* islands of Fiji? If he does not, why does he urge the statement as an argument against my views?

I am glad to see that he is prepared to admit that the various well-known phases of development of atoll-shaped reefs are "indirect evidence" of the truth of what I have maintained; but the Funafuti bore, he thinks, does not support it. The reviewer states that he does not think "the borings in the lagoon at Funafuti suggest a reef such as surrounds a lagoon." I should not have expected them to have suggested a reef such as *surrounds* a lagoon, for that reef is a consolidated and specialised "breccia platform." What might be expected is that such a bore would show the characters of a submerged reef—the open coral bank—*plus* the lagoon accumulations added since the completion of the atoll.

When such a successful bore is driven we may look for such appearances; but it is surely within the knowledge of the reviewer that the only bore at Funafuti which met with any success was *not situated in the lagoon.* The lagoon bore ("bore L") penetrated only 144 feet, and then failed; the only successful bore (on the results of which alone any safe argument may be based) was situated on the seaward reef, far removed from the lagoon. The successful bore ("main bore"), which reached a depth of 1114 feet, was driven on the extreme windward edge of a large atoll reef. In such a situation one would confidently expect the bore to penetrate the talus slope of the outwardly growing reef, and, from the description of the core obtained, it would appear that this expectation was realised. The Funafuti "main bore" tells little of the development of atolls save that they grow to windward on their own talus slopes—a fact hardly requiring a laborious boring for its acceptance.

The "L bore" can support no particular theory by reason of its very incompleteness; but such evidence as it does afford in no way contradicts, but rather goes to support, the supposition that it penetrated the lagoon débris of a submerged reef.

Whether the reviewer regards the Funafuti boring as evidence supporting Darwin's theory of subsidence or Sir John Murray's theory of solution I cannot quite determine; but he next defends the solution theory in the case of the Fijian Islands. He says that these islands have reefs "which superficially appear to be of the ordinary coral-reef type. Such reefs cannot have existed when the islands were first elevated, and it seems to me that Agassiz's photographs show that high islands do crumble to pieces within the calm of encircling barrier reefs." I own that I fail to follow this argument, for, granting that the reef is new since the island was elevated, what proof—or what probability—is there that the coast erosion was not present before the development of the reef, when the same condition is seen quite apart from reefs, or any other coral structures, all over the world?

The problem of the formation of coral structures (fringing reefs, barrier reefs, open reefs, atoll-shaped reefs, and atolls) is not, I think, to be solved by appeals to a multitude of opposed theories, and no critic's position is likely to gain strength by a series of fallacious arguments based alternately on the theory of subsidence, the theory of solution, and the results of the Funafuti bore.

F. WOOD-JONES.

St. Thomas's Hospital Medical School.

As a reviewer I would point out that I do not desire to uphold any theory, but merely to show what is good and what is bad in the book which I am reviewing, what facts are new, how far these and other facts support any theories, &c. An essay on the duties of a reviewer might be a suitable suggestion to the Editor of NATURE, but obviously I am not the author to present such an article.

In the first paragraph of Mr. Wood-Jones's letter of October 27 I am practically accused of being an "anonymous destructive critic" of, I suppose, the constructions erected by the facts brought together by Mr. Wood-Jones, some of them new and some old. I regard some of the bricks of his building as faulty, and I scarcely think there are enough bricks with which to complete the building. I intended to indicate in my review that I considered that science had gaine by the attempt to build, and I desired indirectly to indicate some of the bricks which I thought future workers should attempt to collect. I do not believe any researcher on the coral-reef problem will consider my review as in any way unfair if he regards (*as I did*) Mr. Wood-Jones's book as a *contribution to science.*

I shall after this letter not continue this correspondence, not caring for Mr. Wood-Jones's style of writing. I would, however, make myself clear on two points. Mr. Wood-Jones admits that he assumes the lagoon of an atoll to be a slightly submerged reef. I point out that the nature of the material underlying the lagoons of atolls is doubtful. I appeal to the lagoon boring at Funafuti as giving the most valuable facts we have as to its nature. Do these facts, the best known geographical facts, support the theory of a *slightly submerged reef*, such as is supposed to exist at Cocos-Keeling? Down to 27 fathoms the first Funafuti lagoon boring passed through lagoon débris, and from that depth to 41 fathoms there occurred some firmly compacted masses of coral rock. In the second boring, which was carried to nearly 36 fathoms, a similar section was obtained. I do not consider that these two borings are sufficient to justify Mr. Wood-Jones's assumption, and I did not consider that the evidence given as to Cocos-Keeling lagoon justifies it. I quite fail to remember any description of the material under the Cocos-Keeling lagoon such as would suggest the open coral bank which is mentioned in Mr. Wood-Jones's letter, while its shallowness made it a peculiarly favourable place for investigation.

The fringing reefs round the high limestone islands in Fiji I certainly am inclined to regard as platforms left at low tide-level when those islands were washed away. In this sense they are new. They formed part of the bases of the islands when they were first elevated. Possibly the edges of these platforms have extended seaward since the land was removed by solution, and, still more important, by the erosion of the numerous small particles carried in the swirling waters. I consider these views are amply supported by published evidence. High limestone islands are also being washed away within barrier reefs, and I think it is a fair inference from the evidence that many of these barrier reefs were once similar shelves cut out from the land, or, to put it another way, left behind when the land was removed.

THE REVIEWER.

Note on Winter Whitening in Mammals.

I HAVE just seen a letter in NATURE of March 24 by Miss I. B. J. Sollas, in which, commenting on Mr. Mudge's observations, it is suggested that the yellow body produced artificially by Mr. Mudge in the fur of the albino rat is a substance similar to the yellow pigment of the stoat's winter coat, and therefore probably represents a stage in the reduction of the pigment to the condition in which it exists in the white hairs.

I had previously read Mr. Mudge's observations with great interest, and had suggested to him that they would throw light on the hitherto unexplained yellow tints in

the fur of the winter-whitened stoat, as well as in the permanently white polar bear. I think Mr. Mudge's observations are a distinct help to us in getting at the meaning of these white coats. I should like to see what Miss Sollas can do with the hair of the variable hare, as in the whitened specimens of this animal I have never seen any trace of the yellow tints found in the stoat.

Mr. Mudge's note that the white areas of a piebald mouse can be turned pink by immersion in 5 per cent. nitric acid in 78 per cent. spirit, but only in summer or a warm temperature, is also of great interest. Does it not suggest a reason why pink colour in feathers is mostly found in summer plumages and in warm climates? And is not his production of brown in the hairs of white rats exposed to damp warm weather comparable with the well-known saturated tints so prevalent in animals living naturally in damp but warm countries?

While writing on winter whitening it may be well to direct attention to another point, which has always been difficult to explain on physiological grounds, namely, the fact that the black ear tips of the hare and the black tail tip of the stoat are not subject to winter whitening. This, however, would be explicable if, whereas the general body coat of both these animals is cast twice a year, the black hairs on the ears and tail are renewed only once a year. If they are renewed only once they must remain (apart from fading) of the same colour throughout the year. That such a single moult is possible, and even probable, in these two instances is shown by the fact that in the squirrel there are two moults of the general body coat, but only one of the ear tufts and tail hairs. Similarly in the Equidæ (according to Ewart), there are two moults of the general coat but one only of the mane and tail.

G. E. H. BARRETT-HAMILTON.

Kilmanock House, Campile, Co. Wexford, Ireland, November 3.

Helium and Geological Time.

I MUST apologise for an error in my letter published in NATURE of November 3. The sixteenth line and onwards should read "... for we have no knowledge of chemical affinity between helium and solid substances; while, in respect of solubility, it would probably be inferior to the other gases."

R. J. STRUTT.

Imperial College of Science, South Kensington.

THE SUBANTARCTIC ISLANDS OF NEW ZEALAND.[1]

THE naturalists of New Zealand have always shown themselves eager to take advantage of any opportunity for extending our knowledge of the fauna and flora of their country. Such opportunities are presented from time to time by the periodical official visits of the Government steamer to the outlying islands. In November, 1907, the s.s. *Hinemoa* deposited a large party of New Zealand men of science on Auckland and Campbell Islands, calling for them again on her return trip more than a week later. The expedition was undertaken at the instance of the Philosophical Institute of Canterbury, primarily for the purpose of extending the magnetic survey of New Zealand to the outlying southern islands, but the volumes before us consist chiefly of zoological and botanical observations, though there are also articles on geophysics and geology.

The work has been issued under the editorship of Dr. Charles Chilton, and the publication has been rendered possible by a substantial subsidy from the New Zealand Government. It comes at an opportune moment, and acquires a special interest in relation to the exploration of the Antarctic continent now in progress.

FIG. 1.—Cliffs of Columnar Basalt, Enderby Island. From "The Subantarctic Islands of New Zealand."

The time at the disposal of the expedition was, of course, all too short for a complete biological survey, and the collections were evidently, at any rate in many cases, very fragmentary, but many very interesting results were obtained. The zoologists were undoubtedly right in devoting most of their energies to the terrestrial fauna, which is much more likely to be modified or even exterminated by human agency than the marine fauna, but we cannot help wishing

[1] The Subantarctic Islands of New Zealand. Reports on the Geo-Physics, Geology, Zoology, and Botany of the Islands lying to the South of New Zealand. Based mainly on Observations and Collections made during an Expedition in the Government Steamer *Hinemoa* (Capt. J. Bellons) in November, 1907. Edited by Prof. Charles Chilton. Vol. i., pp. xxxv+388; vol. ii., pp. 389–848. (Wellington, N.Z.: Philosophical Institute of Canterbury. London: Dulau and Co., Ltd., 1909.) 2 vols. Price 42s. net.

that the latter had received a little more attention. No fewer than 168 species and varieties of Foraminifera were discovered by Mr. Chapman in the dredgings sent to him, and if other groups are equally well represented in these seas there must be a rich harvest waiting to be reaped. Incidentally we may note the surprising and very satisfactory fact that of these 168 species and varieties of Foraminifera, from a practically unknown region, only four species and two varieties had to be described as new! Such a record gives one hope that some day our systematic knowledge of the marine fauna will be approximately complete. In the report on the sponges, on the other hand, Prof. Kirk mentions only two species, and of holothurians there were only three.

A large proportion of the collections, both botanical and zoological, has been worked up and reported on

FIG. 2.—Young Sea-lion (*Arctocephalus hookeri*), Carnley Harbour, Auckland Islands. From "The Subantarctic Islands of New Zealand."

by local naturalists, Prof. Benham, Prof. Chilton, Prof. H. B. Kirk, Mr. Edgar Waite, Mr. Henry Suter, Mr. E. V. Hudson, Mr. T. Brown, Mr. T. F. Cheeseman, Dr. L. Cockayne, Mr. R. M. Laing, and Mr. Donald Petrie, many of whom also took part in the expedition. Other collections were sent to specialists in other countries and reported upon by them.

Amongst the more interesting forms obtained, we may note two new species of land nemertines, from Auckland and Enderby Islands, a remarkable addition to this extremely limited group. These are described by Mr. A. D. Darbishire, who contributes some useful notes on the taxonomic value of certain anatomical characters. In addition to the purely systematic reports, we have others of more general interest. Thus Dr. Cockayne contributes a long essay on the ecological botany of the islands, with a number of beautiful photographic illustrations, and Dr. Chilton gives us an account of the history of the scientific investigation of the islands, and a very useful summary of the biological results of the expedition, especially from the biogeographical point of view.

The results in general appear to support the current view that the existing islands of New Zealand are mere fragments of a very much larger land area, which at one time extended southwards beyond Campbell Island, eastwards beyond Chatham Island and Antipodes Island, and north-westwards towards New Guinea. Thus the fauna and flora are essentially Novæ-Zealandian in aspect, but with a large Antarctic element which may perhaps be accounted for by a former northward extension of the Antarctic continent. The existence of an Antarctic continent has, of course, long been used in explanation of certain striking resemblances between the fauna and flora of New Zealand and those of South America, but, as Dr. Chilton points out, we must also suppose that at some former time the climate of Antarctica was sufficiently mild to allow of the existence of a far more abundant animal and vegetable population than we find there to-day. Such a supposition is justified by the geological observations of recent Antarctic expeditions. Fossil leaves were found near the winter quarters of the *Discovery*, and coal still further south by Shackleton, while the Swedish Antarctic expedition met with abundant fossil plants in rocks of Tertiary age on Seymour Island, indicating a temperate or subtemperate climate.

In conclusion, we must congratulate the New Zealand naturalists on the performance of a fine piece of work, and at the same time express our regret that they still have to labour under numerous disadvantages. Of these the want of adequate scientific libraries appears to be one of the most serious. The New Zealand Institute, with its various local branches, has for many years past played a most useful part in promoting scientific research in the dominion, and it appears to us that the Government might do well to assist in some scheme whereby the defect referred to might be remedied, and the necessary scientific literature provided, not only for Wellington, which is the headquarters of the New Zealand Institute, but also for those large provincial towns where the principal branches of the institute are situated.

ARTHUR DENDY.

BIRD MIGRATION.[1]

OF all the many problems of animated nature awaiting solution, few, if any, have of late received more attention than—perhaps the most mysterious of all—the migration of birds.

Mr. Eagle Clarke and the other painstaking observers working with him have during the last few years learnt and taught us much, but only enough to show that still, as Prof. Newton wrote some twenty years ago, "our ignorance is immense."

What is the propelling power which at the appointed seasons sets the great hosts in motion? It seems now at least probable that almost every bird is in some degree migratory, and that even the robins and thrushes that come to the windows for crumbs in winter are more often than not other birds than those which nested in the garden in the spring.

When and how in the long-past eternity were the great aërial highways from zone to zone first marked out, to last apparently for all time? Our boasted

[1] "Ornithological Notes from a South London Suburb, 1874–1909. A Summary of Thirty-five Years' Observations, with some Facts and Fancies concerning Migration." By F. D. Power. Pp. 60+chart. (London: Henry J. Glaisher, 55–57 Wigmore Street, W.) Price 3s. 6d. net.

Roman roads, Aitken streets and Watling streets are, compared to these, things of yesterday.

How is the knowledge of the chart passed on, without fault or break, from generation to generation? If old birds led the way the matter would be less incomprehensible. But, writes Herr Gätke, as "the *incontestable result*" of fifty years' watch in Heligoland:—

"under normal conditions, the autumn migration is initiated by the young birds from about six or eight weeks after leaving the nest.

"The parents of these young individuals," he adds, "do not follow until one or two months later"!

How and under what physical conditions are the journeys made?

Mr. Pycraft is a writer to whom ornithologists already owe much, and from whom they confidently look for more. His views will always carry weight, but they may change. Just now he thinks it "hardly necessary to attempt to bring rebutting evidence" to confute Herr Gätke's closely-reasoned argument that migration flights must be made at speeds which,

"Through the mists and vapours,
Amid these earthly damps,"

may well seem incredible; but, with atmospheric resistance removed, need seem no longer so.

The veteran ornithologist's dream of "the existence of a special respiratory mechanism, enabling birds to remain in strata of the atmosphere beyond the reach of all other organised beings," may yet prove true. There are things more improbable. Then we shall think nothing of flights at a speed of "a hundred and eighty miles an hour."

"Airy navies grappling in the central blue"

not many months ago seemed impossibilities. Now they seem uncomfortable probabilities.

These are a few only of the questions which have yet to be answered before we can hope to understand what the migration of birds means. The answers are not likely to be given in the lifetime of our generation, if ever. It is only by the patient collation of trustworthy observations, spread over a long series of years, that any general conclusions can be hoped for. We may sow, but others must reap.

A modest and unpretending little volume, lately published, "Ornithological Notes from a South London Suburb, 1874–1909," by Mr. F. D. Power, is a useful contribution to the general stock of knowledge of a fascinating subject. The first chapters of the book, well worth publication though they are, will appeal rather to local than to general readers.

It is interesting to know what birds are to be looked for in one's own neighbourhood, and where and when they have been seen there. But there is not much to be said of thrushes and tits in Surrey or Middlesex which is not to be noted as well in other counties.

There is the usual sad tale to tell—and it is very well told—of wild life crowded out by growing human populations.

The lake in Dulwich Park, for instance, was once, Mr. Power writes, a favourite resting-place for passing ducks. He has seen "on and about this comparatively small sheet of water seven species not observed elsewhere in the district. In one day in October, 1898, there were five scaups and four shovellers on the lake, and the tufted duck nested on the island for three or four years." The common sandpiper was a regular visitor, and the kingfisher not uncommon. Boats have been placed on the water, and "the saddened bird-lover has now little chance of even an early morning note of extra interest."

On Mitcham Common, once a favourite nesting-place of many small birds, golf balls have taken the place of eggs.

It is in the "Migration Notes," and more especially in a broadsheet table printed at the end, that the chief interest of the volume for ornithologists living beyond the "South London Suburb" will be found, and a very real interest it is.

Mr. Power has, during a long succession of autumn migrations, kept careful records of the forces and direction of the wind and of the size and direction of the flights passing within sight of his garden. In a simple and admirably clear chart, the results of his observations are shown for every day, without a single gap, for the month of October for twenty-five years.

The rather surprising conclusions to which his observations have led him would seem to find at least *prima facie* justification in the facts tabulated. He sums up as follows:—

"It used to be supposed, and by many the idea is still held, that birds come and go with wind favouring them. . . . My observations during these many years have convinced me that migrants travel best and by choice *against* the wind. . . . My experience is [he is speaking of the autumnal migration] that the only *visible* and *sustained* migration *in numbers* is invariably in a N.W., W., or S.W. direction *almost directly against the wind*, even when such approaches a stiff breeze, the birds in their progress meeting the wind on the right or left breast."

The italics are Mr. Power's.

The photograph of "the garden from which the migration notes were taken" does not, certainly, suggest exceptionally favourable opportunities.

His little book, like Alphonse Kerr's delightful "Voyage autour de mon jardin," shows how much is to be seen by "the observing eye" without going far from home.

T. DIGBY PIGOTT.

NEW DISCOVERIES AT KNOSSOS.

ON September 16 a letter appeared in the *Times* from Dr. Arthur Evans, describing the results of his excavations this year at Knossos. All archæologists will congratulate themselves on the fact that Dr. Evans has passed out of the path of politics, which he had essayed to tread, back into the more peaceful (?) ways of archæology. For there were many more things that we wanted to know about Knossos, and one of them has been made clear by the work of this season. The great domed pit, the *tholos*, as it seemed to be, over which part of the southern quarter of the palace was built, has been excavated to the bottom, not without danger to the workmen. And it turns out to be a great *tholos*-like reservoir, with a spiral staircase round the inside of it, which breaks off, as in other similar cases, at what must have been the average water-level. The springs that supplied this reservoir are now dry, and no doubt were so before the place was entirely filled up. This was done, as we know from the character of the potsherds found in it, in the first "Middle Minoan" age.

"In other words the reservoir itself belonged to the Early Minoan Age, and was filled in at the time of the construction of the first Palace of which we have any existing remains—the object of the work being to obtain a secure foundation for the South Porch and adjoining parts of the outer wall. The filling materials themselves were probably supplied by the levelling away at this time of the summit of the 'Tell' of Knossos in order to gain the area for the Central Court of the Palace." There was also a smaller reservoir on another part of the mound, "and from the magnitude of the work we may well conclude that some earlier predecessor of the Great Palace already existed on the site that it has since occupied."

This is an important conclusion. If we are to judge by the reservoir, the early Minoan palace was probably a great architectural work. The "Early Minoan III." architects were perhaps almost as capable as their contemporaries, the Egyptian pyramid-builders of the fifth and sixth dynasties.

In the small "palace" on the hillside west of Knossos further discoveries have been made, including a paved way with the rut-marks of ancient Minoan chariots. In this part of the site more recent remains, of classical and Roman date, constantly are found above the Minoan level; whereas in the main palace, "whether owing to a superstitious awe or to other causes, the hilltop . . . was never invaded by later habitations." A fine metope of a Doric temple, contemporary with the Parthenon sculptures, was found over the western palace.

Mr. Doll has proceeded with the work of conserving the palace buildings, and has run the great staircase another flight higher. Also the nature and composition of the frescoes have been studied by Mr. Noel Heaton.

In the tomb-field of Isopata further important discoveries have been made, owing to the *flair* of Gregori, Dr. Evans's Cypriote foreman,

"the most expert tomb-hunter of the Levant. . . . The wild, long-rooted fennel, which seeks out by preference the spots above ancient cuttings, served him, as often before, as a guide, and the result was the discovery of six chamber-tombs, some of which for their size and the interest attaching to their contents and arrangement surpass any hitherto known of this class."

The date of the tombs is the second late Minoan period, about 1450 B.C., contemporary with the eighteenth dynasty of Egypt. The most remarkable point about these tombs is the information as to Minoan religion which they give us. In one tomb, where "the religious interest culminated," was found an arrangement wholly new, which "rather recalled the domestic Etruscan ideas of the after-life than anything yet known of the Minoan age." The tomb was made to resemble a house of the living, with stone-cut benches, as if for family gatherings. And at the head of the sepulchral cist were found the remains of a double-axe shrine, with an offering-vessel, in the shape of a bull's head, lying close by. These tomb-chambers seem not to have been kept open regularly, but were opened for solemn service on the anniversary of the death probably. They were rifled of their more valuable contents by robbers of the early Iron age (geometrical period), who left behind them traces by which we can identify their date.

"It will be seen that the 'Tomb of the Double Axes' has produced more definite evidence regarding the sepulchral cult and religious ideas as to the after-world than any grave yet opened in Crete or prehistoric Greece."

Dr. Evans's comparison of the interior of the tomb with that of an Etruscan grave is very apposite and suggestive. This Etruscan impression has already been given by the great painted sarcophagus found by the Italians at Agia Triada, and it is most interesting to see how a relationship between the Etruscan, Minoan, and Anatolian (Hittite) cultures in matters of religious cult is gradually becoming clearer to us.

H. R. HALL.

NOTES.

THE following is a list of those who have been recommended by the president and council of the Royal Society for election into the council for the year 1911 at the anniversary meeting on November 30:—*President*, Sir Archibald Geikie, K.C.B.; *treasurer*, Mr. Alfred Bray Kempe; *secretaries*, Sir Joseph Larmor and Dr. John Rose Bradford; *foreign secretary*, Sir William Crookes; *other members of the council*, Mr. L. Fletcher, Dr. W. H. Gaskell, Sir David Gill, K.C.B., Dr. E. H. Griffiths, Prof. W. M. Hicks, Prof. F. S. Kipping, Major P. A. MacMahon, Mr. H. R. A. Mallock, Dr. C. J. Martin, the Duke of Northumberland, K.G., Prof. W. J. Pope, Prof. J. H. Poynting, Prof. E. Rutherford, Mr. A. E. Shipley, Mr. M. R. Oldfield Thomas, and Mr. Harold W. T. Wager.

THE Royal Society's medals have this year been adjudicated by the president and council as follows:—The Copley medal to Sir Francis Galton, F.R.S., for his researches on heredity; the Rumford medal to Prof. Heinrich Rubens, for his researches on radiation, especially of long wave-length; a Royal medal to Prof. Frederick O. Bower, F.R.S., for his treatise on the origin of a land flora; a Royal medal to Prof. John Joly, F.R.S., for his researches in physics and geology; the Davy medal to Prof. Theodore W. Richards, for his researches on the determination of atomic weights; the Darwin medal to Mr. Roland Trimen, F.R.S., for his South African bionomic researches, in large part undertaken as the outcome of correspondence with Charles Darwin; the Sylvester medal to Dr. Henry F. Baker, F.R.S., for his researches in the theory of Abelian functions and for his edition of Sylvester's "Collected Works"; the Hughes medal to Prof. John A. Fleming, F.R.S., for his researches in electricity and electrical measurements. The King has been graciously pleased to approve of the award of the Royal medals.

AT the meeting of the Royal Society of Edinburgh held on November 7, the following honorary fellows were elected:—*British:* Prof. J. G. Frazer, Sir Joseph Larmor, F.R.S., Dr. Alfred Russel Wallace, O.M., F.R.S. *Foreign:* Prof. Hugo de Vries, Amsterdam; Mr. F. A. Forel, Morges; Prof. Karl F. von Goebel, Munich; Prof. J. C. Kepteyn, Gröningen; Prof. Elie Metchnikoff, Paris; Prof. A. A. Michelson, F.R.S., Chicago; Prof. W. Ostwald, Leipzig; Prof. F. W. Putnam, Harvard University; and Prof. A. F. L. Weismann, Freiburg (Baden).

IT is reported from Stockholm that the Academy of Sciences has decided to award this year's Nobel prize for physics to Prof. J. D. van der Waals, of Amsterdam, for his work on gases and liquids.

WE regret to see the announcement of the death of Mr. Theodore Cooke, for many years principal of the Poona College of Science, at seventy-four years of age.

A REUTER telegram from Wellington, New Zealand, states that Mr. Priestly, who accompanied Sir Ernest Shackleton, as geologist, on his Antarctic expedition, is going out with Captain Scott in the place of Mr. Thompson, who is ill.

THE date of the annual exhibition held by the Physical Society of London, which was fixed some time ago for December 13, has been altered to Tuesday, December 20. The exhibition will be open in the afternoon as well as in the evening.

THE annual Huxley memorial lecture of the Royal Anthropological Institute will be delivered on Tuesday, November 22, at the theatre of the Civil Service Commission, Burlington Gardens, W., by Prof. W. Boyd Dawkins, F.R.S., whose subject will be "The Arrival of Man in Britain in the Pleistocene Age."

MRS. TYNDALL has presented to the Royal Institution two Nicol's prisms, constructed for the lectures on light given by Dr. Tyndall in America in 1872, and used by him sub-

sequently in his researches and lectures; also two pieces of rocksalt, the remains of a large block given to Dr. Tyndall by the King of Württemberg in 1867.

THE eighty-fifth Christmas course of juvenile lectures, founded at the Royal Institution in 1826 by Michael Faraday, will be delivered this year by Prof. Silvanus P. Thompson, F.R.S., his subject being "Sound, Musical and Non-musical: a Course of Experimental Acoustics."

THE General Purposes Committee of the Birmingham City Council has recommended to the council that an invitation be given to the British Association to meet in that city in 1913. The council will cooperate with the University and other public institutions in making the necessary arrangements.

THE death is announced of Dr. Carl S. N. Hallberg, professor of pharmacy in the Chicago College of Pharmacy in connection with the University of Illinois. He was born in Sweden in 1856, and emigrated to America when a lad. He organised in 1885, and subsequently directed, the National Institute of Pharmacy. Since 1906 he had edited the Bulletin of the American Pharmaceutical Association.

THE Simon Newcomb library, which has been presented to the New York City College by Mr. John Claflin, has just been classified and catalogued. It is a collection of 4000 volumes and 6000 pamphlets, and includes many mathematical and astronomical publications of unusual interest. Among them may be mentioned an early edition of Euclid's Elements, a Pacioli of 1494, the 1515 edition of the Almagest of Ptolemy, and the first book ever published on sun-spots.

MR. G. M. MEYER sends us an extract from the Madrid weekly periodical *Nuevo Mundo* of October 6 in which a Spanish case of eugenic policy is described. It appears that an illustrious Salamancan, Don Federico Gómez-Arias, founded an annual prize of 1000 pesetas, which is awarded every year to a young woman of Salamanca from fifteen to twenty-three years of age, of good physical constitution, attractive, and well conducted, who must have received at least an elementary education and be on the point of being married to a man of similar physical and moral condition and of suitable age.

BY the generosity of Sir Julius Wernher, who recently placed a sum of 10,000*l.* at the disposal of the committee for the purpose, a much needed extension of the department of metallurgy of the National Physical Laboratory has now been commenced. The department has been accommodated in scattered rooms in Bushy House, which, in consequence of the increase and importance of the work, have become quite inadequate. Plans have been prepared in consultation with Dr. Rosenhain, the superintendent of the department, and the contract has been let to Messrs. Dick, Kerr and Co., who have already made good progress with the foundations.

THE programme for the 157th session of the Royal Society of Arts is being issued to the members. There will be five ordinary meetings before Christmas, at the first of which the usual address will be given by the chairman of the council, Sir John Cameron Lamb. The papers announced for the other four meetings are by Sir Henry H. Cunynghame, K.C.B., "Detecting Fire-damp"; Mr. C. P. Ogilvie, "Argentina"; Dr. Vaughan Cornish, "The Panama Canal"; and Mr. Reginald Smith, "Roman London." There will also be a meeting of the Colonial Section, at which Mr. A. Montgomery will read a paper on "Mining in Western Australia," and one of the Indian Section to be occupied by a paper by Mr. R. F. Chisholm, on "The Taj Mahal." On the four Mondays before Christmas Mr. C. R. Darling is to give a course of Cantor lectures on "Industrial Pyrometry." There is also a very full list of papers and lectures for the part of the session after Christmas.

A QUARTERLY periodical entitled the *Botanical Journal* is issued as the official organ of the Royal Botanic Society of London. The first number contains an account of the history of the society since 1839, the date of the Royal Charter, in which are set forth the objects which have been served in that period. In recent years progress has been impeded by a lack of sufficient financial support, and consequent increase of debt, but the latest report shows that in some measure, at least, this condition is being remedied. The number of Fellows now is 1834, as compared with 1570 last year. The debenture debt is 14,714*l.*, as compared with 24,248*l.*, and the current liabilities 572*l.* instead of 3050*l.* Prof. A. J. Ewart, of Melbourne University, has an article on "The Flora of Victoria," and other subjects treated upon include "Our Native Lawns," "The Melbourne Botanic Gardens," "Fruit-growing in Queensland," and "Art in the Garden." There are notes upon botanical questions of interest and recently issued books. Two plates in colour from paintings by Miss Bertha Maguire prettily illustrate chrysanthemums, but their value is purely decorative, for they shed no light on the evolution of the flower, as would appear to be the case from the title. Mr. Butler's colour photographs are welcome, because they illustrate interesting plants in the society's collection. The number is not entirely free from the blemishes common to first issues: especially is this the case in the awkwardness of some of the titles to the subject-matter. The journal is issued by Messrs. Page and Pratt, and the price is one shilling.

THE Bulletin of the Johns Hopkins Hospital for October (xxi., No. 235) contains an appreciation of the life and work of Lord Lister, by Mr. Charles Judd, with bibliography; an historical inquiry on the decussation of the pyramids (nerve tracts in the brain), by Dr. Thomas; and an historical sketch of the practice of blood-letting, by Dr. Joseph Smith. Dr. Thomas ascribes the first definite observation of the crossing in the medulla of the great motor tracts passing from the brain to the spinal cord to Francois Pourfour du Petit (1664–1741). The practice of blood-letting or "bleeding" is at least two thousand years old, and is mentioned by the earliest medical writers.

UNDER the provisions of the Indian Museum Act of 1910, the ethnological and art collections have been separated from those of economic products, and in his last report of the museum as originally constituted, the curator, Mr. I. H. Burkill, has given a useful account of its past history and present condition. The museum was first started by the Asiatic Society in 1814, the first donor being the Countess of Loudoun. The collections have passed through many vicissitudes, due to the absence of suitable accommodation. Under the present scheme of reorganisation they have at last been placed upon a satisfactory footing. The ethnological gallery now contains about 11,000 exhibits, but it still lacks a proper descriptive catalogue, which can be prepared only by a competent ethnologist. The progress of the art series has been stimulated by the patronage of Lord Curzon, who provided an annual State grant of about 400*l.* for the purchase of specimens. Most of the older economical exhibits have perished, but these are being gradually replaced. It is satisfactory to learn that these important

collections are now being arranged in suitable galleries, and it only remains for the Government of India to provide a series of descriptive catalogues prepared by competent experts, which will render the exhibits available for study by students of art, anthropology, and the exonomic sciences in Europe.

PART 8 of vol. v. of the Annals of the South African Museum contains five articles on the entomology of the country. Among these, Mr. E. Meyrick continues his description of new Microlepidoptera, while Messrs. A. Raffray and L. B. Billecoq treat, in separate communications, of two groups of Coleoptera.

To the *Journal of Economic Biology* for October Messrs. Collinge and Shoebotham contribute a long article on the Apterygota (Thysanura and Collembola) of Hertfordshire, to which they have devoted special study. Before they commenced there appear to have been no records of these minute insects from the "county of Hertfordshire," but the authors are now enabled to enumerate four species of Thysanura and sixty-nine of Collembola.

To the *Anales* of the National Museum of Buenos Aires, ser. 3, vol. xiii., p. 317, Dr. F. Ameghino contributes a note on certain teeth from a cavern in Cuba, which are referred to a large monkey the dental formula of which is identical with that of the Cebidæ, but the cheek-teeth of which are stated to approximate to those of Old World monkeys and man. For this monkey the new generic and specific name of *Montaneia antropomorpha* is proposed. It is noteworthy that no wild monkeys are found in Cuba at the present day.

IN the October issue of the *Journal of Economic Biology* Prof. Hickson discusses the place of economic zoology in a modern university, and the best way of training students in that branch of science. After pointing out that there is a growing demand for the services of men capable of dealing with the problems of economic biology in a practical manner, the author observes that the qualifications usually associated with what is termed "a good field-entomologist" will not suffice, and that a man who aspires to a post of this nature must have a working acquaintance with parasitism, parthenogenesis, heredity, and embryology; while he should possess special knowledge of the Protozoa, parasitic worms, land and fresh-water snails, and, particularly, tracheate arthropods. Such a course of study "could be given in the zoological departments of the principal universities of our country without very much additional equipment or a very material addition to the numbers of the teaching staff. But in order that the student may have the opportunity of getting some training in the recognition of insect pests in the field, the work of the laboratory should be supplemented by some systematic teaching in connection with an institution of the nature of an agricultural college, in which access to growing crops may be facilitated."

THE question of the systematic position and feeding-habits of the African Jurassic genus Tritylodon, and its northern allies Plagiaulax and Ptilodus, is reopened by Dr. R. Broom in the October issue of the Proceedings of the Zoological Society. In the first place, the author has no doubt as to Tritylodon being a mammal, while as the only known specimen is from the Stormberg beds, it must be regarded as of Lower Jurassic, and not Triassic, age. As regards the affinities of the three genera, Dr. Broom refuses to admit that Mr. Gidley is justified in including them among the diprotodont marsupials, remarking that the dentition, both structurally and numerically, is of a different type, while the presence of a well-developed septomaxillary in the African genus suggests monotreme rather than marsupial affinities. It is also pointed out that there is a considerable probability of diprotodonts having originated in Australia. "In the present state of our knowledge it seems wisest to leave the Multituberculata as a distinct independent group with no very near affinities with the living monotremes, marsupials, or eutherians." As regards the food of these mammals, the author points out that fruits were non-existent in Jurassic times, while if, as he considers probable, Tritylodon and its relatives were carnivorous, they must have fed mainly on reptiles, which would require a type of dentition different from that of mammal-eating species.

A NOTE on a fungal disease of the blue pine, *Pinus excelsa*, reported from the Simla forestry division, is contributed to the *Indian Forester* (October) by the assistant to the imperial mycologist at Pusa. The chief object of the note is to establish the observation of infection proceeding from diseased to healthy roots, for which good evidence is adduced. The fungus is reported to be *Trametes pini*, for which such marked fungal development in the root, and infection from root to root, has apparently not been previously recorded.

MESSRS. FLATTERS, MILBORNE AND MCKECHNIE, of Longsight, Manchester, are issuing a quarterly publication of fifteen pages entitled the *Micrologist*. Part ii., issued October 1, contains two excellent articles, one on mounting microscopical objects in fluid media in cells, the other (by Mr. H. E. Hurrell) on the polyzoa and the methods of collecting and mounting them. It is well printed and illustrated, and contains a beautiful plate of five reproductions of photomicrographs of starch, volvox, hydra, &c.

A USEFUL list of pteridophyta for the Transvaal province is communicated by Mr. J. Burtt-Davy to the *South African Journal of Science* (October) on behalf of the late Mr. V. G. Crawley and himself. To make the list serviceable to teachers and students, brief diagnoses are supplied for the classes and genera, while analytical keys and localities are given for the species. Among the true ferns, *Cyathea Dregei* and *Mohria caffrorum* are two remarkable common species; *Oleandra articulata*, *Todea barbara*, and *Marattia fraxinea* are said to be rare. With respect to the number of species, Asplenium, Pellæa, and Gymnogramme are conspicuous genera.

MR. W. N. LUBIMENKO publishes in the botanical section (series iii., parts i.–ii.) of *Travaux de la Société des Naturalistes de St. Pétersbourg* a long paper (in Russian) in which he presents the results of experiments directed towards ascertaining the relationship that exists between the amount of chlorophyll present in a leaf and the energy of photosynthesis. In the summary it is stated that the minimum intensity of light required to start photosynthesis depends on the amount of chlorophyll, being less as the amount of chlorophyll is greater; also that as the amount of chlorophyll increases the energy of photosynthesis increases up to a maximum, and then decreases. It is further suggested that certain experiments indicate that photosynthesis proceeds in two stages; first, CO_2 is decomposed and O is liberated, then certain photochemical reactions lead to the transport and incorporation of organic material.

A CORRESPONDENT sends us examples of a monstrous carnation in which the inflorescences have produced no true flowers, but a superabundance of bracts. This

peculiarity in carnations and certain species of Dianthus was observed many years ago (see "Vegetable Teratology," p. 371, by M. T. Masters). An example is illustrated in the *Botanical Magazine*, Tab. 1622, in which one bud has developed into a perfect double flower, and several others are exactly similar to those sent by our correspondent. Earlier than this, Linnæus had met with a similar malformation, and given it the name of *imbricatus*. The distorted flower buds so nearly resemble ears of wheat that they are known as "wheat ear" carnations. It is not known what causes the suppression of the other parts of the flower and the increase in the number of bracts, but Masters pointed out that the condition is met with frequently in a species of Mœsa, in *Plantago major*, and in *Gentiana Amarella*.

Hitherto agricultural chemists have concentrated attention mainly on those constituents of the soil that are essential to the production of plant food, but recently attempts have been made to ascertain the effect of the non-essential or the rarer constituents. The investigations at Woburn are well known. Mr. Failyer, of the United States Department of Agriculture Bureau of Soils, has published (Bulletin 72) a number of analyses showing that barium is present in most soils in the United States, especially in soils derived from rocks containing barite deposits or from the Rocky Mountains. The quantity sometimes rose near to 0·1 per cent. Felspar is also a source of barium. It appears probable that the soil moisture, which plays a part in the nutrition of plants, contains barium salts, and cases are on record where barium has occurred in the plant ash. Its presence there would be injurious to animals, and may perhaps be the cause of some of the unexpected results occasionally produced by vegetation.

M. Aug. Chevalier, in a letter on his explorations in Upper Dahomey, published in the last number of *La Géographie* (October 15), mentions a curious phenomenon which he observed with respect to the Ouémé River. In its middle course, last May, he found during his stay of fifteen days that the stream ran continuously in a reversed direction, toward the head of the river. The gradient of its bed in this part is very small, and the upper reaches are completely dry during several months of the year, as is the case with most of the rivers of the central African plateau. The rainy season sets in earlier in the downstream part of the country and fills the empty channel, which then runs for a time both ways until equilibrium is established, after which the normal direction of flow is maintained. Similar abnormalities have been previously observed in some of the water-channels of the Kalahari desert in south-central Africa.

In Nature of October 20 (p. 503) reference was made to an article in the *Times* on the Norwegian expedition to Spitsbergen, which contained a somewhat detailed account of the discovery of a volcano of recent age in a branch of Wood Bay. It appears, however, that there is still some doubt about the age of the volcanic phenomena. The latest number of *La Géographie* (xxii., No. 4, October 15) includes a note on the results of the expedition by M. Charles Rabot, based on an article in the Christiania *Aftenpost*, sent to him by Captain Isachsen, the leader of the expedition, as the only official communication which has yet been published. On this authority the following reference is made in *La Géographie* to the discovery:—"Finally, round a branch of Wood Bay, Mr. Hoel [one of the geologists] has made the very unexpected discovery of an ancient volcanic development (*appareil*). Contrary to what has been announced from Spitsbergen correspondence published in Christiania journals, it does not date the actual epoch, and for a long time has not been the seat of manifestations. At present, upon the shores of Bock Bay the internal activity manifests itself only by the presence of thermal springs, of which the temperature does not exceed 28·5°." The scepticism respecting the earlier newspaper accounts of the volcano, alluded to in our previous note, was therefore not altogether unjustified. The full particulars of the discovery will be examined with keen interest by geologists and geographers.

The Bureau of Science, Department of the Interior, Manilla, has issued the annual report on the mineral resources of the Philippine Islands for the year 1909. It is thoroughly characteristic of American methods that the United States Government should have straightway set about fostering the development of the mineral industry of their first colony. The success that has attended this attempt is clearly enough indicated in the present report. The main product up to the present has been gold, the output of which for the year 1909 is valued at about 49,600*l.*; it shows an increase of 14 per cent. over that of 1908, in which year the output was about three times that of the year previous. Even more important from the point of view of general industrial development and civilisation is the increase in the production of coal; the total quantity raised in 1909 was 30,336 tons, an increase of 155 per cent. over the previous year, and more than seven times as great as the production in 1907. The entire production now comes from two mines on the island of Batan, one at the extreme east and the other at the extreme west of the island. The seams now worked are from 3 feet 4 inches to 5 feet 8 inches in thickness. The coal appears to be of Tertiary age; it is classed as sub-bituminous, is low in ash, and has given satisfactory results in raising steam. From the scientific point of view the chief interest of the report centres in a very brief sketch of the geology and geological history of the Philippine Islands.

The Meteorological Committee has issued a useful contribution to the study of the north-east and south-east trade winds of the Atlantic Ocean (Publication No. 203), comprising (1) an investigation by Commander Hepworth with the view of tracing any effect of the variations of those winds upon the temperature of the water in the North Atlantic; (2) a *résumé* of the meteorological data available for St. Helena, by Mr. J. S. Dines; and (3) a calculation, by Mr. E. Gold, of the relation between the periodic variations of wind velocity and of atmospheric pressure, with the application of the general theorem to the case of St. Helena. In Nature of December 21, 1905, Dr. Shaw directed attention to an apparent connection between the circulation of the atmosphere, as represented by the south-east trade wind, and the meteorological consequences in other parts of the world, and the present work may be considered as an attempt to identify that connection, to trace the links in the chain of cause and effect, and also to supply information available for meteorologists interested in the subject. In a very lucid preface summarising some of the results Dr. Shaw points out that the marine discussion of the south-east trade wind shows hardly any seasonal variation (possibly due to the peculiarities of the Beaufort wind-scale), while the results for the north-east trade show a marked variation very nearly complementary to that at St. Helena, where the anemometer record exhibits a regular mean variation (irrespective of direction) between about 14 miles per hour in May and 21 miles per hour in September. Dr. Shaw points out that Mr. Gold's solution, on dynamical prin-

.iples, of the origin of the diurnal variations of the trade wind over the South Atlantic gives results which are hopeful, but not final.

THE well-known observatory on Mount Vesuvius was founded in the days of the Kingdom of Two Sicilies, and was taken over by the Government at the time of the unification of Italy. The work that it has done under the direction of Prof. Palmieri, and latterly Matteucci, is well known; but in a plea put forward in the *Atti dei Lincei*, xix., 3, Dr. Carlo dei Stefani states that the institution has been hampered by the want of a more substantial subsidy from the State, and he further directs attention to the desirability of establishing a much more extensive institution for the study of Vesuvius in all its aspects. It is pointed out that since the observatory was founded every branch of science has advanced enormously, that the study of volcanoes plays an important part in geology and geophysics, and that Vesuvius, from its situation as well as from our intimate knowledge of its past history, offers exceptional facilities for systematic study. In such an institution the departments of geology, mineralogy, chemistry, and physics should all be represented on the staff.

THE geometry of the triangle occupies a somewhat unique position in mathematics, leading as it does to a large number of results which appear to be capable of being added to almost without limit, which do not require the employment of advanced methods for their study, and have the further interesting peculiarity—perhaps not altogether a disadvantage—that they can be studied without afterthoughts as to probable utilitarian applications. We have received two papers on this subject. One is by Mr. W. Gallatly (London: Francis Hodgson, price 2s. 6d.), dealing with Lemoine and Brocard points, angular and tripolar coordinates, pedal and antipedal triangles, the medial triangle, Simson's line, the orthopole, and orthogonal projection. The second, by Mr. W. H. Salmon, is a note reprinted from the *Quarterly Journal of Pure and Applied Mathematics*, dealing with the Omega and Omega-prime lines and the γ line. These lines are defined by the property that if O be any point in the plane of a triangle, and the lines OA, OB, OC be rotated through a constant angle, they will, for certain angles of rotation, meet the sides taken in order in three points lying on a straight line, these lines being the lines in question.

PROF. L. PALAZZO has sent us a copy of his "Misure Magnetiche fatte in Sardegna nel 1892," extracted from vol. xxiv. of the *Annali* of the Italian Meteorological Service. This volume belongs to the year 1902, but the chronological order has not been observed in the publications of the Italian Meteorological Service—some of which are much in arrears—so that an account is only now published of the magnetic survey of Sardinia made by Prof. Palazzo in 1892. Sixteen stations were occupied, the observations at which are described in minute detail, the results being embodied in a chart. No really large local disturbances were detected, but some minor disturbances were noticed, especially towards the north-west of the island. Besides a full description of the observational methods and reductions, there are descriptions, with plates, of apparatus for determining the temperature and induction coefficients of collimator magnets, with which very consistent results seem to have been obtained.

IN the May number of the International Bulletin of the Academy of Sciences of Cracow Prof. Smoluchowski, of the University of Lemberg, gives an account of some measurements he has recently made of the heat conductivities of fine powders, and the influence of the size of the grains and the state of the gas between them on the conductivity. His apparatus is in principle identical with that used by Kundt and Warburg in their measurements of the heat conductivities of gases. It consists of a thermometer the bulb of which is surrounded by a tube nearly concentric with it, the space between the bulb and tube being filled with the powder and connected to a Gaede pump, so that it can be filled with a gas or evacuated. Whatever the nature of the powder, the conductivity through the gas between the grains is found to diminish rapidly as the pressure of the gas is reduced, and for granular, as distinguished from spongy, powders its dependence on the pressure may be calculated by the aid of the kinetic theory of gases if the surface resistance, which depends on the mean free path of the molecules of the gas, is taken into account at the low pressures.

COPIES have reached us of the volumes of magnetic data recorded during 1905 and 1906 at the observatories of the U.S. Coast and Geodetic Survey. There are five of these observatories, viz. at Cheltenham, Baldwin, Sitka, Honolulu, and Vieques (Porto Rico). The Cheltenham volume is dated 1909, the others 1910. Thus the delay in publication seems hardly accounted for by the inclusion of two years' data in the same volume. The procedure followed and the mode of presenting the data are closely alike at all the stations. Full particulars are given of all the hourly readings and of the daily maxima and minima, but only the ten quietest days of each month are employed for deducing the diurnal inequalities. Each volume contains a table of the principal magnetic disturbances, and some of the curves showing them are reproduced on a reduced scale. Except at Cheltenham, the times shown on the curves are G.M.T., thus facilitating intercomparison, but the times of commencement, &c., given in the text are in local mean time. The stations are now all provided with a complete outfit of Eschenhagen magnetographs, including vertical force instruments. The troubles experienced—discontinuities in the trace, changes of scale value, drift of trace across the sheet, and general instability—are described in some detail, and though most prominent in the vertical force instruments, seem by no means confined to them. Even the declination instrument gave serious trouble at Baldwin, leading to considerable loss of trace. One cannot but experience a doubt whether a more stable and less sensitive type of instrument would not have been preferable, especially at the less accessible stations. In addition to other troubles, Sitka suffered from an outbreak of dry rot, which necessitated a large amount of internal structural alteration in the magnetograph room. This led, however, practically to no loss of trace, the magnetographs being accommodated during the alterations in a temporary building. In addition to magnetic data, there are particulars of the seismic movements recorded by seismographs, mostly of the Bosch-Omori pattern.

A LIST of observing stations and particulars of the apparatus employed in connection with the *Michael Sars* North Atlantic Deep Sea Expedition, 1910, has just been received. An article by Dr. Johan Hjort describing the work of the expedition is given in another part of the present issue.

MESSRS. HENRY SOTHERAN AND CO., 140 Strand and 43 Piccadilly, London, have issued a new classified catalogue (No. 709) of second-hand books on geology,

mineralogy, mining, and metallurgy, including the library of the late Prof. Hilary Bauerman, with a supplement of sets of periodicals and publications of the learned societies.

THE Cambridge University Press has undertaken the publication of a work entitled "Principia Mathematica," by Dr. A. N. Whitehead, F.R.S., and the Hon. B. Russell, F.R.S.; the aim of the work is to show the dependence of mathematics upon logic by deducing from purely logical premises the elementary propositions of various branches of mathematics. The first volume, on mathematical logic and prolegomena to cardinal arithmetic, will be published very shortly. The second volume, concerning the principles of arithmetic, is in the press. In the third volume the authors have dealt with measurement and the principles of geometry.

WE have received the first part of vol. xviii. of the Journal of the Royal Institution of Cornwall. The proceedings at the annual and spring meetings of 1909 are given at length. The annual excursion of 1909 is described, and the address of the president, Dr. Richard Pearce, at the spring meeting in 1909 is printed *in extenso*. Among papers read at the meetings during 1909 may be mentioned:—King Arthur's Hall on Bodmin Moor and some Irish circles, by Mr. A. L. Lewis; the fauna of St. Ives Bay for 1908, by Mr. R. Vallentin; and the invertebrate fauna of Cornwall—Hymenoptera Entomophaga and Hymenoptera Aculeata, by Mr. W. A. Rollaston. The volume also contains meteorological tables for Cornwall for 1909.

OUR ASTRONOMICAL COLUMN.

FIREBALL ON NOVEMBER 2.—A brilliant fireball was observed on Wednesday, November 2, 7.46 p.m. It passed from east to west over the English Channel, and fell from heights of 84 to 26 miles. As seen from Cornwall and from the north of France, as well as from ships in the Channel, the meteor was a splendid object, yielding a brilliant light, as though the moon had broken out from clouds. The stream of aërolites from which the phenomenon was directed has its radiant point in Aries, and further observations are desirable.

ROTATION OF THE MOON.—A correspondent has been puzzled by the perennial perplexity of non-mathematicians as to how the moon can be said to rotate when she always presents the same face to the earth. The answer, of course, is that as we prove the rotation of the earth by the fact that any meridian, such as that of Greenwich, completes its circuit with respect to any fixed star in the course of a *sidereal* day, so also the similar consideration shows that the moon rotates on her axis in $27\frac{1}{3}$ days, during which time she also completes her circuit about the earth with respect to the stars.

The moon's equator is not quite circular, since her figure may be considered as possessing a solidified tidal inequality of shape. Laplace examined the mechanical results of this condition of affairs, and showed that the moon would oscillate slightly about a mean position relatively to the earth. This is called the physical libration of the moon, and in consequence of its existence we see slightly more than half of the moon's surface.

It is probable that the moon once rotated more rapidly on her axis, and that her rotation was reduced by tidal friction to its present magnitude. The transition from a slow rotation to a libration would present a problem of considerable mathematical difficulty. We can, however, see what would be the several stages through which the changes would pass. There would first be unequal speed in the several parts of the rotation; this inequality would increase until at two moments in one rotation that rotation would nearly cease; then there would occur an actual stoppage, and the direction of motion would reverse itself for half a rotation, constituting a very large libration; finally, the amplitude of libration would diminish to its actual insignificant magnitude.

EPHEMERIS FOR HALLEY'S COMET.—Dr. Ebell publishes a continuation of his ephemeris for Halley's comet in No. 4450 of the *Astronomische Nachrichten*. The ephemeris covers, in four-day steps, the period November 5 to December 31, and shows that the comet is now travelling in a south-westerly direction through Corvus; its magnitude is about 15·5.

SELENIUM PHOTOMETER MEASURES OF THE BRIGHTNESS OF HALLEY'S COMET.—Observing at the Illinois University Observatory, Mr. Joel Stebbins measured the brightness of Halley's comet with his selenium photometer on fifteen occasions during May, and now publishes the results in No. 2, vol. xxxii., of the *Astrophysical Journal*. The selenium cell was attached to the 12-inch refractor, and, through a diaphragm, light from a circle 7 minutes of arc in diameter was admitted to it; Mr. Stebbins suggests that eye-estimates of the comet's brightness never included a larger area. The cell is known to be especially sensitive near the red end of the spectrum, and it is supposed that, unless the spectrum of the comet was very peculiar, the systematic error of these observations would be less than visual comparisons of a luminous surface with a point source of light, such as a star; extra-focal images of stars were used in the comparison, and in the morning observations the brightness of the sky was measured and taken into account in adopting final values for the comet's brightness. The range of the latter is shown by the following values, given in magnitudes:—May 3, 2·0; May 11, 0·6; June 1, 3·6. The second value, 0·6, is vitiated by bad observing conditions, but Mr. Stebbins states that the comet became brighter than the first magnitude, although it never reached magnitude 0·0.

THE APPARENT DIAMETER OF JUPITER.—An earlier discussion of the observations of an occultation by Jupiter, made at the Zô-sè Observatory on May 21, 1908, led to the conclusion that the apparent diameter of the planet, as generally adopted, should be diminished; the occulted star was BD. $+19°$ 2095.

In No. 4450 of the *Astronomische Nachrichten* Father Chevalier, director of the Zô-sè Observatory, suggests that the observational results were not sufficiently certain to have such an important conclusion based upon them.

Attempting to determine more trustworthy data, he measured a photograph of the planet taken on May 19, and determined the corrections to the tabular place. Then applying these differences he found the position for May 21. This gave the position-angle of the star as $140° 23'$ and its distance from the centre of Jupiter as $18·7''$, a value greater than the semi-diameter of the planet. It is difficult to reconcile this result with the data for the occultation, and Father Chevalier urges that the observations made at other observatories should be closely examined and discussed from this point of view. A number of discussions such as he now publishes would possibly elucidate the matter

CURVED PHOTOGRAPHIC PLATES.—In No. 161 of the Harvard College Observatory Circulars Prof. E. C. Pickering describes some interesting experiments made for ascertaining the practical efficiency of curved plates in celestial photography.

With the 16-inch Metcalf telescope employed, the difference in focus between the edge and the centre of the plate is only 0·8 mm., but the experiments show that the bending of the plates to the focal curve is advantageous, while there is little likelihood of counterbalancing disadvantages.

Several methods were tried, such as holding the ordinary photographic plate against a properly curved concave surface by means of mucilage, &c., but it was found that the most successful method was to have the space between the plate air-tight, and then to exhaust it by means of a pump. Reproductions of actual photographs illustrate the gain in definition over the whole plate.

THE "MICHAEL SARS" NORTH ATLANTIC DEEP-SEA EXPEDITION, 1910.

IN the month of August last year, Sir John Murray approached me with the liberal offer of defraying the expenses of a deep-sea expedition to the Atlantic Ocean, provided the Norwegian Government were willing to lend their research-vessel, *Michael Sars*, for the purpose. Sir John Murray wished to ascertain whether the appliances and instruments used by the *Michael Sars* for her work in the Norwegian Seas would yield new information in the Atlantic. It was, besides, considered desirable to examine parts of the Atlantic that had previously been only very slightly explored. The Norwegian Government at once signified its willingness to accept this proposal, and I accordingly employed the past winter in making preparations for the expedition, assisted by the captain of the vessel, Mr. Thor Iversen, Prof. H. H. Gran, who agreed to lead the investigation of phytoplankton, and Mr. Helland Hansen, who took charge of the hydrographical researches. For my own part, I decided to cooperate with Mr. E. Koefoed, and to devote myself especially to zooplankton and the study of the bottom-fauna.

The expedition left Bergen at the end of March, arrived at Plymouth—where it was joined by Sir John Murray—and then followed the coasts of Europe and Africa down to Cape Bogador, carrying out special investigations in the Bay of Biscay, the Bay of Cadiz, and the waters between the Canary Islands and Africa—thirty-four stations in all. It next undertook a section into the Sargasso Sea, and after touching at the Azores, proceeded right across the Atlantic to St. John's, Newfoundland (forty stations). From there a section was taken to the south coast of Ireland (twenty-two stations), and, finally, we concluded our investigations by examining the waters between Scotland and Rockall and between Scotland and the Faroes—that is to say, north and south of the Wyville Thomson ridge—so as to study the influence exerted by the Atlantic Ocean upon the Norwegian Sea. The route of the expedition will be seen on the accompanying sketch (Fig. 1).

During this cruise we endeavoured, so far as time permitted, to undertake hydrographical and plankton investigations simultaneously, and we further carried out a considerable number of hauls with the trawl.

The large number of observations and specimens thus secured can, naturally, not be fittingly described before being systematically studied, and it is accordingly only possible as yet to furnish information regarding their nature and extent.

HYDROGRAPHICAL INVESTIGATIONS.

Hydrographical investigations have been carried out at about 110 stations. The temperature readings were taken with Richter's reversing thermometer and Nansen's thermometer, while the water-samples were collected by means of Ekman's water-bottle and the Petterson-Nansen isolated water-bottle. At most of the stations the temperatures have been recorded by two thermometers simultaneously at each depth, no fewer than 519 simultaneous readings being taken with the same two thermometers. The corrected temperatures gave an average difference of 0·01° Centigrade.

The difference between the two thermometers was :—

In 168 cases	0·00°
In 231 ,, ...	0·01°
In 84 ,, ...	0·02°
In 36 ,, ...	0·03° or over.

A fair number of simultaneous observations have been made with the reversing thermometer and Nansen's thermometer in the isolated water-bottle, with the view of observing the adiabatic effect by means of the difference in pressure. Besides the temperature readings, we have taken water-samples from all depths to determine the salinity and specific gravity, and we have endeavoured to get an exactitude in the determinations of salinity of 0·01–0·02 per mille, and in the density *in situ* an exactitude of 1–2 in the fifth place of decimals. On these lines the investigations have been carried out along the whole route of the expedition. We have, further, procured about 100 large water-samples from different stations and depths, for the purpose of determining the quantitative occurrence of nitrogenous substances, particularly ammonia.

The determinations from the deepest layers (down to 4950 metres) have given very uniform results, with a temperature of 2·48 C. It has been found that there is a very faint increase of temperature near the bottom at great depths, due, possibly, to the conduction of heat from the interior of the earth or a radium effect. In the upper layers conditions have varied considerably at times, especially in the neighbourhood of the Gulf Stream area and in the western portion of the North Atlantic. Here our investigations furnish apparently a number of new and interesting results, which, however, it is impossible to do more than

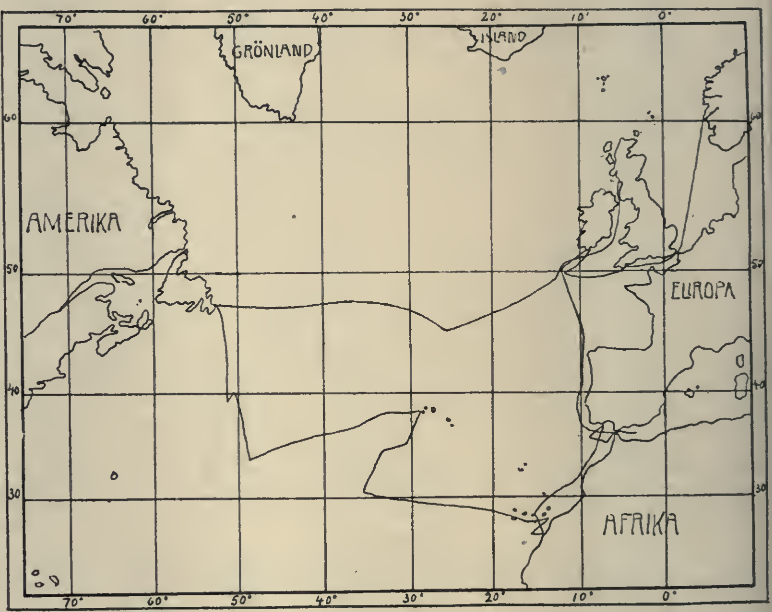


FIG. 1.

allude to before the water-samples have been thoroughly examined.

Surface temperatures have been recorded every hour during nearly the whole cruise, while every two hours a water-sample has been taken from the surface with particulars of the different meteorological conditions (wind, barometer, temperature of the air, humidity, and cloudiness). Altogether we have about 2500 water-samples and about 3000 temperature readings.

Several series of direct-current measurements have been made with Ekman's propeller current measurer. In the Straits of Gibraltar the current was so strong that we encountered no small difficulty in regard to anchoring. However, we succeeded in the course of a day in obtaining altogether seventy good measurements from eight different depths between the surface and the bottom. There were considerable tidal fluctuations both in the west-going surface current and in the deep east-going current; simultaneously with the fluctuations in the strength of the current the boundary between the two streams shifted upwards and downwards, as clearly appears from repeated series of temperatures and water-samples. The boundary lay at a depth between 50 and 100 fathoms below the surface. Velocities of four knots or

more were on several occasions recorded in both the surface current and the undercurrent; in the majority of cases, however, the velocity varied between 1 and 2½ knots.

On the slope south of the Azores the *Michael Sars* was anchored in 500 fathoms. Here about ninety current-measurements were made at different depths. In the deep sea between the Azores and the Canary Islands a series was taken right down to 2000 metres, from the vessel while under slow, steady drift, with one of the large tow-nets out as a drift-anchor. These measurements also show considerable fluctuations, which are apparently connected with tides. Similar investigations with modern methods have never been undertaken before either in deep water or in the Straits of Gibraltar.

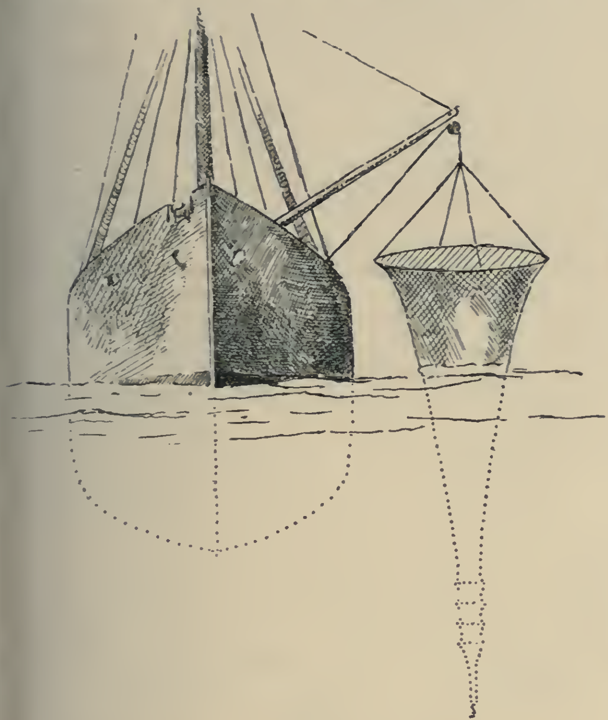


FIG. 2.

A number of measurements of light were also made in the ocean south and west of the Azores. Mr. Helland Hansen has constructed a new photometer which worked well; he determined the quantity of light by the aid of panchromatic plates with and without gelatine colour filters. The investigations showed a great influence of light rays at 100 metres, red being the weaker, and blue and ultra-violet rays the strongest; at 500 metres blue and ultra-violet rays were still found, and even at 1000 metres the influence of the ultra-violet rays was clearly evident. No trace of light could be noticed on the plates at 1700 metres, after an exposure of two hours at noon with a clear sky.

PHYTOPLANKTON.

Vertical hauls have been undertaken at various depths, at fully forty stations, with a fine-meshed Nansen closing-net, our object being to collect material for studying the vertical and horizontal distribution of peridinæ and diatoms in the Atlantic Ocean. We specially aimed at obtaining material for comparing the plankton of the coast-banks with plankton from purely oceanic waters, as also for comparing subtropical and boreal conditions of existence. The coast-banks off Ireland, Cadiz Bay, the west coast of Africa, and the Newfoundland banks have a characteristic flora which is sharply marked off from the oceanic flora, rich in species but poor in individuals, which is met with in the central parts of the Atlantic Ocean, especially the Sargasso Sea south of the Azores.

Largely owing to Lohmann's interesting researches in the Mediterranean, we arranged to devote a considerable part of our work to the study of those organisms, especially Coccolithophoridæ and the naked flagellates, which pass through even the finest silk net. These organisms have been partly collected by filtering sea-water through sand filters and partly by employing a large centrifuge driven by a small steam winch. Altogether we have employed the centrifuge in the case of about sixty of these water-samples; and, by means of a suitable contrivance, Prof. Gran was able to examine these samples on board in their living state, both in regard to quality and quantity.

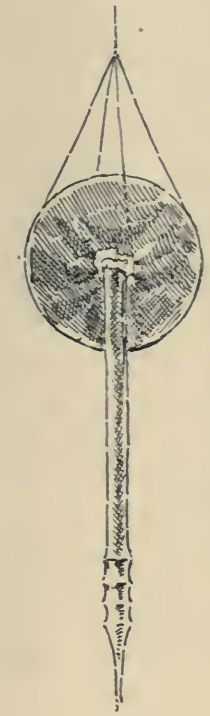


FIG. 3.

Examination showed a large number of new forms, partly belonging to quite new types, which will be described by Prof. Gran. In the central oceanic parts of the Atlantic Ocean these small organisms were found to occur in numerous forms and in such large quantities that they exceed in volume the plants obtained through the medium of the silk nets. In the neighbourhood of the European coast-banks the number of species was far smaller, but the quantity of individuals was particularly large. Thus we secured in a single sample more than 200,000 individuals per litre of one species alone. On the coast-banks off Newfoundland and off Ireland the peridinæ far exceeded in volume the Coccolithophoridæ.

Altogether the samples from the more northerly waters show a greater quantity of plants than the subtropical portion of the ocean. The material will likewise furnish information with regard to the distribution of phytoplankton in relation to depth. In the more northerly waters its range is limited to a thinner, less deep-reaching layer than in the more southern portion of the area of investigations.

ZOOPLANKTON.

For the study of smaller plankton animals, of the size of copepods, for instance, we employ a vertical closing-net, one metre in diameter, with rather coarser silk. With this we took samples at various depths and at many stations.

However, I perceived from the very first that an appliance of this sort would not be able to afford us much information regarding the occurrence of the larger pelagic animals, such, for instance, as cephalopods, decapod crustaceans, and deep-sea fishes. Both the *Challenger* and *Valdevia* expeditions employed, as will be remembered, a big tow-net, with which they made many vertical hauls from great depths to the surface of the sea. By this means they caught a certain amount, though by no means a

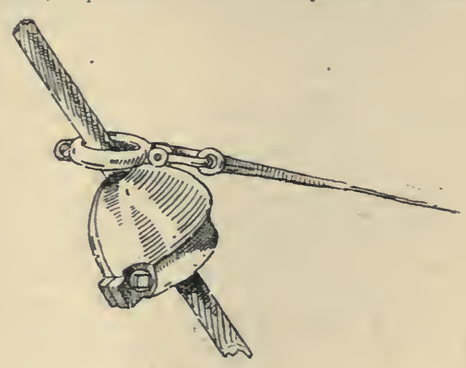


FIG. 4.

particularly large quantity, of fish in proportion to the number of hauls; and they naturally obtained but little information regarding such questions as the depth at which the animals live, and their vertical wanderings by night and day. These questions seemed to me to be of special interest at the present juncture, and accordingly an essential part of the work of our expedition was directed towards their solution. We first constructed some large nets of 3·25 metres diameter, partly of coarser silk and partly of prawn-net, arranged to close on the principle of Nansen's closing net (see Figs. 2 and 3). With these we made several successful hauls at various depths, and obtained sufficient catches of the commonest forms to enable us to determine more approximately the actual depth at which they occur. Nevertheless, we soon discovered that even these large nets yielded merely an incomplete collection of the fauna, since many species occur far too sparsely to be caught with vertical hauls. It was therefore found necessary to employ large horizontal-fishing appliances and to make hauls of considerable length.

Such hauls would, however, take an unduly long time, if they were to be carried out singly at the same station, for hours in succession, at different depths. It was, therefore, particularly desirable to drag a number of appliances at several depths simultaneously. The appliances had in this case to be fastened to one or two wire ropes, as one cannot tow many wires at the same time. The technical difficulty now presented itself that long lengths of wire get twisted, when towed, and consequently destroy the appliances or displace their position in the water. We solved this by an arrangement, shown in the accompanying figure (Fig. 4), by which a shackle to which the appliance is fastened moves freely round the wire. By this means it became possible to have no fewer than ten appliances out simultaneously from two wires, as shown in the figure (Fig. 5). Here we see a series, consisting partly of nets, partly of Dr. C. G. Joh. Petersen's young-fish trawls, in use at the following lengths of wire: 0, 100, 200, 300, 600, 1000, 1500, 2000, 2500, 3000 metres. The total number of these towing stations exceeded thirty.

The material obtained in this way was very large indeed. From the same station hundreds of pelagic deep-sea fishes and litres of large decapods, medusæ, &c., were secured. All the same, the hauls showed that the material was not by any means too large, since right up to the very last haul we continued to capture a few species of pelagic fishes that had not occurred in any of the previous hauls. The largest net, in particular, worked splendidly. We have thus discovered quite a number of species of pelagic deep-sea fish not previously described.

As there were so many stations, and we fished in widely differing waters and at all hours of the day and night, a comparison of these catches with each other will afford much information concerning the geographical distribution of the different species, as well as regarding the depth at which they occur by day and by night, and so on. The catches show that the hauls have much in common, and we may accordingly assume that they are in the main representative of the depth in which the appliances have been towed; and it is further extremely satisfactory to note that the experiences gained from these hauls and from the vertical closing-net are in close accordance.

It is too soon yet, and, moreover, would take too long, to describe in full the results of our experiences. I will confine myself, therefore, to mentioning that everywhere in the Atlantic Ocean, from the Wyville Thomson Ridge to the Sargasso Sea, there appears to be, at depths below 400 metres, a consistently uniform fauna of small, chiefly black pelagic fish, large red crustaceans, numerous medusæ, &c., a fauna which, in any case so far as the fishes are concerned, is probably also shared by other oceans, and which presents the same variety of form that the *Valdivia* expedition, for instance, has found in the Indian Ocean, and the *Challenger* in the Pacific. In the upper layers, at depths less than 400 metres, we have discovered numerous younger stages of fish that are not as yet determined, mostly of transparent, colourless form, such as Leptocephali, to take merely one example.

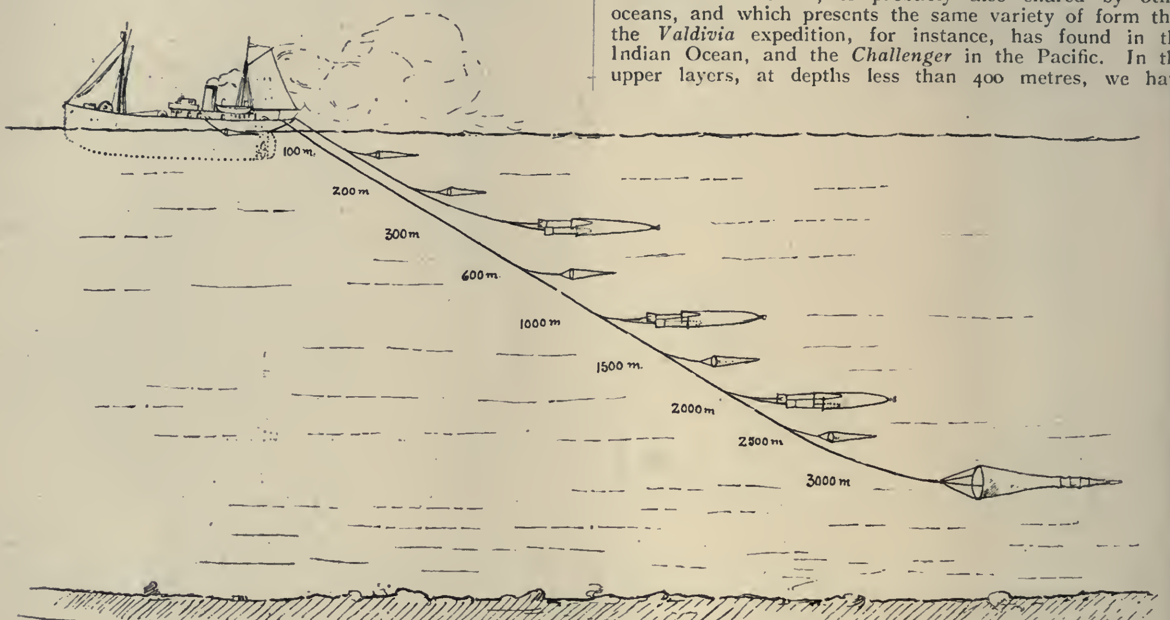


FIG. 5.

TRAWLINGS.

During previous expeditions in the Atlantic Ocean a great number of hauls have been undertaken either with the dredge or with small trawls. There was, therefore, no pressing necessity for the *Michael Sars* to investigate the bottom-fauna of the Atlantic, more particularly as hauls of this nature require a considerable expenditure of time, and could therefore with difficulty be combined with our exacting programme of hydrographical and plankton investigations. It was of interest, on the other hand, to try whether a large-sized model of the ordinary otter-trawl (with 50 feet of head-rope) would yield new results. During my previous researches I had succeeded to my satisfaction, and had secured very good catches, by making use of a trawl of this kind at depths down to 1000 fathoms. It was, in my opinion, especially desirable to employ this appliance along the Continental slope from the Wyville Thomson ridge southwards to the tropical coast of Africa, so as to ascertain the composition of the fauna on this long stretch at depths varying from 500 to 1600 fathoms.

Besides, I considered it of the utmost interest to attempt some hauls far out from the coast-banks on an oceanic deep plain with depths descending to 3000 fathoms. Altogether we have carried out twenty-two hauls at various depths with this large trawl.

It will be seen that our trawl had a greater capacity than any of the appliances previously employed, and that it can therefore, without doubt, be recommended for investigations of the deep-water fish-fauna. This is especially the case where it is requisite to have many individuals for examination. For invertebrate organisms, on the other hand, smaller and more handy appliances may be preferable.

Essentially new types of fishes the trawl cannot be said to have taken. But the material we possess furnishes a good picture, especially of the uniform fish-fauna to be met with along the slopes of the coast-banks of Europe and Africa from the Wyville Thomson ridge down to Cape Bogador, and it also shows clearly the sharp transition from the southern to the northern side of the Wyville Thomson ridge, which the *Triton*, the *Knight Errant*, and my own investigations, amongst others, had previously demonstrated.

The hauls at great depths (about 5000 metres) were no doubt few, perhaps too few; but they accorded with each other and with the hauls made by previous expeditions, more especially those of the *Challenger*, *Travailleur*, and *Talisman*, in indicating that the actual eastern deep-ocean plain of the Atlantic is especially poor in all kinds of higher organisms and particularly in fish. It might, by some naturalists, be regarded as a desert region. A fuller discussion of our observations must, however, be reserved for a more comprehensive publication.

JOHAN HJORT.

THE ASSOCIATION OF TEACHERS IN TECHNICAL INSTITUTIONS.

THE annual meeting of the Association of Teachers in Technical Institutions was held at the Northern Polytechnic, London, on Saturday, November 5. In moving the adoption of the annual report of the council, Mr. J. Wilson (Battersea Polytechnic), the retiring president, stated that any further extensive progress in the general technical and scientific education of this country depends upon the adoption of certain educational reforms, for most of which public opinion is now ripe. These reforms may be briefly summarised as follows:—(1) elementary education to be more practical or constructive; (2) compulsory attendance at day or evening (preferably day) continuation schools, with a limitation of the hours of labour of adolescents; (3) the institution of "technical-secondary" schools; (4) the linking of the elementary school through the continuation and secondary school to the technical school; (5) the increased provision of scholarships, with adequate maintenance grants, so that the qualified day and evening technical student may receive the highest possible technical and scientific training. These suggested reforms are all quite practical, and their adoption would entail but relatively little strain upon the financial resources of this country, while the commercial and educational results would be of incalculable benefit.

Attention was directed to the promise held out in the Prefatory Memorandum to the recent Board of Education regulations for technical schools, that the Board would take action, in the near future, with respect to certain of the more pressing of the educational reforms just referred to. A significant statement in the memorandum, relating to the payment of grants for technical instruction to institutions of university rank, together with the recent formation of a "University Branch" at the Board of Education, emphasises the modern tendency towards bringing the English universities within the purview and influence of the national educational authorities The hope was expressed that this would result in the opening wider of the doors of the university to the community, and a closer connection of the universities with all phases of educational effort in this country.

The recent regulations of the Board of Education respecting the registering of the attendance of day and evening students at technical institutions were criticised adversely, inasmuch as by considerably increasing the time and attention to be devoted by the teacher to the merely mechanical work of registration, they inevitably detract from the efficiency of the teaching as a whole.

In discussing the first volume of the minutes of evidence submitted to the Royal Commission on University Education in London, Mr. Wilson stated that in this evidence there appears vague and unjust criticism of the higher work of the London polytechnics, generally based upon want of knowledge of the work these institutions are now doing.

The president of the association for 1910–11 is Mr. Barker North, of the chemistry and dyeing department, Bradford Technical College.

METEOROLOGICAL RELATIONSHIPS.

PROF. H. HILDEBRAND HILDEBRANDSSON is continuing his important series of papers on the centres of action of the atmosphere, and the fourth communication, recently received, is entitled "Sur la Compensation entre les types des Saisons simultanés en différentes régions de la Terre" (*Kungl. Svenska Vetenskapsakademiens Handlingar*, Band 45, No. 11). In his third paper he suggested that the principal cause of the different types of seasons depended very probably on the condition of the ice in the polar seas, and the evidence he brought forward was such as to show that this view had very much in its favour. In the present communication he makes a closer study of these compensations between the types of simultaneous seasons in both winter and summer seasons, and extends his researches to North America. He further directs attention to some analogous results which he finds exist in the southern hemisphere. Thus he finds both in winter and in summer that there occurs an opposition between the north and south of both Europe and of North America, and also probably between the sub-polar regions and sub-tropical regions of the southern hemisphere. There is also, in general, an opposition between the north of Europe and Siberia.

Special attention is directed to some regions where this opposite nature of seasons is in some years less pronounced, and Prof. Hildebrandsson points out that these districts are intermediate between the main centres of typical action, and are therefore dependent on the intensity of the latter. This communication is accompanied by several plates of curves, and these should be closely studied in connection with the text. There is little doubt that these researches will in time open up a field for the future forecasting of seasons, but it is important to bear in mind that so intimate are the meteorological associations between very widely separated regions on the earth, it behoves the investigator to take a very broad view of the subject, and not confine himself to one small portion of the earth's surface.

Mr. E. T. Quayle, of the Australian Commonwealth Meteorological Bureau, has recently (Bulletin No. 5, March) published the results of his investigations in relation to the possibility of forecasting the approximate rainfall for northern Victoria. At the outset he states that it has long been his conviction that ordinary statistical methods must prove inadequate, and that they do not enable the essential differences between the weather of successive years to be grasped. In his study of the storm systems as they have affected Victoria he has made a classification of them, and on this he bases his method of forecasting. The storms which affect Victoria and bring the rain belong to two main systems, one called "Antarctics," which originate in the southern seas, and the other called "Monsoonals," which are of tropical origin. The first-named he divides into two classes:—(*a*) Antarctics, when their centres are too far south to be identified; and (*b*) Antarctic cyclones, when their centres can be located inland or over Bass Strait. The monsoonal low depressions he divides into three groups:—(*a*) monsoonal troughs; (*b*) monsoonal dips; and (*c*) monsoonal cyclones.

By the use of isobaric charts the number of occurrences of each type of disturbance was taken out for each month for the years 1888 to 1909. As the northern districts of Victoria receive most rain chiefly from monsoonal de-

pressions or the fronts of well-developed Antarctics, a typical rainfall curve of the northern areas was constructed. Thus for each half-year the low- and high-pressure systems passing Victoria were counted, and alongside the numbers thus obtained were placed the figures for the rainfall over the northern areas and the mean air pressure and temperature for Melbourne. The comparison brought out the result that an excess in the number of summer monsoonal disturbances was followed by an excess in the winter rainfall in seventeen cases out of twenty-two.

Mr. Quayle then evolves a rough rule for predicting the approximate winter rainfall over northern Victoria, giving the weights of two, one and one to the number of monsoonal disturbances, mean pressure, and mean temperature, respectively, for the preceding summer. Noting the coincidences of sign only in the values he evolves for the calculated winter rain, he finds that they are in agreement with those for the actual departures from normal of the winter rains nineteen times out of twenty-two, and in serious agreement in two cases only. It is unfortunate that, owing to lack of daily isobaric charts, the period could not have been extended over more years; nevertheless, the system may be used tentatively, and the results will be watched with interest.

THE LATITUDE OF ATHENS.[1]

In the volume referred to below M. Eginitis describes the varied activities that exercise the staff of the National Observatory of Athens and of the smaller institutions that his zeal has called into existence and made to yield results useful to science, both as regards seismology and meteorology. It seems not a little strange to find well-remembered names like Thebes, Sparta, Naxas, Samos, and many others famous in the past, figuring in this list, and playing a new *rôle* by contributing climatic observations made on approved lines with modern instruments. Of the last mentioned of these stations, that on the island of Samos, the author remarks, "malheureusement, elle a été complètement détruite, le jour du bombardement de cette île, en 1908, par la flotte turque," recalling a struggle which seems more in keeping with its ancient history than its effort to accumulate meteorological observations.

But the real serious piece of work here described is the attempt to determine the latitude of Athens, a problem that interested Ptolemy, who recorded the value 37° 15′, placing the city some 45 kilometres south of its true site, even when allowance for all known sources of error is made, a larger error than is usual in similar determinations in that age. But error seems to cling to this unfortunate coordinate, for M. Eginitis informs us that the latitude for the Pantheon given in the "Connaissance des Temps" is about 6″ too small. In striving for the nicest accuracy, the director has found the problem to be one of extreme difficulty. He has employed two methods and two instruments, and the results do not coincide. He has employed the Horrebow-Talcott process, carried out by means of an instrument originally intended for a meridian circle, but by removing the microscopes and adding a level, adapted to that particular form of observation. Later, through the generosity of M. Syngros, he was supplied with a modern and excellent meridian circle by Gautier, the construction of which was supervised by M. Lœwy. This instrument was used for determining the zenith distances of both circumpolar stars and stars of known declination, the zero being derived from nadir observations only.

The interest in the discussion consists in the different values obtained after reversing the instrument. The difference is constant and rather larger than has been noted elsewhere. Like the R-D term in similar inquiries, it refuses to yield a satisfactory explanation, however ingeniously solicited. There is no attempt to determine the actual variation of latitude, though the observations extend over a considerable period, nor, as we think, is sufficient attention paid to the possible effect of a "magnitude equation." The inquiry is of a purely instrumental character, and is directed mainly to the legitimacy of employing an arithmetic mean of the values obtained in the two positions of the instrument. If this conclusion is warranted and offers the only possible means of correctly determining the latitude, M. Eginitis is justified in insisting upon the necessity of reversion and of providing for the operation in the construction of the instrument. But as the director promises further experiments and a more rigorous attempt to eliminate all possible sources of error, it will be desirable to pause before offering any criticism or accepting the result as final.

[1] Annales de l'Observatoire National d'Athènes, publié par Demétrius Eginitis, Directeur de l'Observatoire. Tome v. Pp. ii+592. (Athens, 1910.)

EDUCATION IN TECHNICAL OPTICS.

The reawakening of the British optical industry which began with the first years of this century brought with it a demand for the provision of special technical education in optics. The Northampton Polytechnic Institute, from its situation in Clerkenwell, where much of the London optical industry is centred, was particularly suited as a centre for such work, and optical classes were begun there as a branch of work in general physics. The optical trade, however, regarded these classes as being of little value, and in 1902 a new syllabus was adopted and a special department of technical optics was instituted. Since that time this department, under Mr. S. D. Chalmers, has developed very considerably and done much useful work for both day and evening students, but the scope and value of this work has been continually hampered and further development has been completely blocked by want of proper space and equipment. This unsatisfactory state of affairs has been fully realised, and the governors of the Northampton Institute have acquired the necessary land on a site opposite the institute, and have had plans prepared for a complete "Opto-technical Institute"; for the erection and equipment of the building they are, however, dependent on a grant from the London County Council.

The County Council or its predecessors in authority, the School Board, has been repeatedly approached in this matter. A deputation from the Optical Society in 1902 led to a grant which resulted in the establishment of the optics department at the institute; for a time this was supplemented by a grant from the Company of Spectacle Makers, but this has subsequently been replaced by a trade fund, collected principally by the efforts of Mr. J. Aitchison and administered by the Optical Society. In 1905 the Optical Convention sent a deputation to the London Education Committee; this deputation was headed by Dr. R. T. Glazebrook, and included a large number of influential men connected with the science or industry of optics, but, although favourably received, no practical steps resulted for five years.

Now, however, there appears to be a definite prospect that this want of our optical industry may soon be met in an adequate manner. This is indicated by a circular letter issued a few weeks ago by the L.C.C. Education Officer to members of the optical trade in London. In this letter the members of the trade are asked to state their views as to the need for an Opto-technical Institute in London, and to indicate to what extent they or their employés would take advantage of any facilities provided, and what benefits they would expect to derive from such teaching. The letter concluded by inquiring whether, in the opinion of the trade, an expenditure of about 30,000*l.* for a building for such a purpose would be justified, and the general scheme of the new institute as proposed by the Northampton Institute is indicated. This comprises a series of large teaching laboratories and lecture-rooms for instruction in all branches of optics, lens-working and general instrument design and construction being provided for, as well as the theoretical and experimental branches of the subject. The new institute would accommodate 300 to 400 day and evening students, complete day courses as well as evening classes being contemplated.

Fortunately there is every reason to believe that the optical trade will respond to this circular letter in a manner which will fully justify the London County Council in proceeding at once with a scheme which is really of

national importance. An opening meeting of opticians and those interested in optics was called by Mr. J. Aitchison at Anderton's Hotel in Fleet Street on October 17, and an attendance of 300 enthusiastically and unanimously affirmed their approval of the London County Council scheme. This was probably the largest, and certainly the most unanimous, optical meeting ever held in London; all the speakers emphasised the need for close cooperation between science and industry in the optical more than in most other industries, and the consequent need of the best educational facilities for masters and workmen. It is clearly recognised—not in this country alone—that the British optical industry has made and is making a very great effort to regain lost ground; such names as Grubb and Hilger show that there is even now British leadership in some fields of optics. With the help of such schemes as that of the London County Council these fields might well be extended.

THE CRYSTALLOGRAPHY OF HÆMOGLOBINS.[1]

CRYSTALS of oxyhæmoglobin differing greatly in character are figured in every text-book of physiology; but in the absence of specially skilled study by a crystallographer it has always seemed possible hitherto that the differences observed might be dependent on polymorphism, differences in water of crystallisation, effects of environment, or on chemical change, and that hæmoglobin, from whatever source obtained, was essentially one and the same substance. Hüfner's observation that all hæmoglobin solutions giving the same extinction coefficients in the spectrophotometer showed the same capacity for oxygen appeared to support such a view, although it could also be interpreted as showing merely, what was already probable on other grounds, that the hæmatin portion of the molecule was identical in all cases.

Profs. Reichert and Brown, regarding crystalline character, when interpreted with care and knowledge, as a trustworthy criterion of identity or non-identity, have prepared crystals of oxyhæmoglobin and its near allies from some two hundred species of animals, and subjected them to minute crystallographic analysis. Their observations show beyond doubt that hæmoglobin exists in almost innumerable varieties, each of which is more or less characteristic of the species from which it was obtained. In view of the ease with which oxyhæmoglobin undergoes chemical change, the demonstrated impossibility of purifying it by recrystallisation without the occurrence of such change, the effects of admixture with other substances on crystal form, and the difficulties of crystallographic interpretation, it is inevitable that some reserve should be felt in accepting all their conclusions in detail, but the main facts presented can hardly be interpreted otherwise than in the way suggested by the authors.

It is, however, much to be regretted that they have not described the spectroscopic characters of the crystals studied in each case, since the omission of this information leaves it open to doubt whether the material examined was always what it was taken for. In the absence of spectroscopic evidence, their statement that the blood of the horse, python, and many primates, including man, contains in the same individual two different kinds of oxyhæmoglobin, while that of the baboon and some other animals contains as many as three, carries no conviction. Scepticism on this point appears, indeed, to be very much in place in view of the extraordinary statement in the last chapter that "metoxyhæmoglobin," the substance ordinarily known as methæmoglobin, the neutral or acid solutions of which show a four-banded spectrum, becomes converted to oxyhæmoglobin by treatment with ammonia. It is almost impossible to resist the conclusion that the authors are unfamiliar with the spectrum of alkaline-methæmoglobin, and the suspicion that the crystals described as a second kind of oxyhæmoglobin may have consisted of the former substance.

Another interesting statement concerning which ampler justification would have been very welcome is that the blood of the shad during the breeding-season, and that of the bear during hibernation, is especially rich in "metoxyhæmoglobin."

The first two chapters deal very completely with the general properties, and distribution in the animal kingdom, of hæmoglobin, hæmocyanin, and the colourless respiratory substances termed achroglobulins; they contain also some very useful comparisons of the chemical and morphological characters of the blood of different animals, and full references to the literature. The third chapter is devoted to a special consideration of the physical and chemical properties of hæmoglobin, and it is no fault of the authors that Barcroft's important work on this subject had not appeared in time for its inclusion. The rest of the monograph contains an admirable critical account of the work of previous investigators, and a full description of the methods, results, and conclusions of the authors, illustrated by 600 very successful photomicrographs and numerous figures in the text.

The results obtained are of general biological interest, not only as showing that the differences already proved to exist between the corresponding serum-proteins of different animals are equally manifest between their hæmoglobins, but also as throwing light on phylogenetic relations, since the crystals from closely allied species often exhibit close similarities. They are also of great interest to the crystallographer by reason of the extensive isomorphous series brought to light, and some important observations on mimetic twinning of crystals.

[1] "The Differentiation and Specificity of Corresponding Proteins and other Vital Substances in Relation to Biological Classification and Organic Evolution and the Crystallography of Hæmoglobins." By Prof. E. T. Reichert and Prof. A. P. Brown. Pp. xix+338+100 plates. (Washington, D.C.: Carnegie Institution, 1909.)

PROBLEMS OF WHEAT GROWING.

THE October number of *Science Progress* contains an important article on "Wheat-growing and its Present-day Problems," by Dr. E. J. Russell, of the Rothamsted Experimental Station. The article is based very largely upon a discussion which took place at the Winnipeg meeting of the British Association, at a joint meeting of the Botanical, Chemical, and Agricultural Sections. The work of the Rothamsted station has long ago made familiar the main facts in reference to the fertilisation of wheat-fields under normal conditions, but the recent discovery of the use of phosphatic manures in order to secure earlier ripening may prove to be an important factor in extending the northern limit of the wheat-belt; in the same way, it is suggested, the use of late-ripening varieties manured with potassium salts may be of value in extending the southern limit; phosphates have also proved of value in securing rapid root development in the dry soils of Australia, where it is of great importance that the plant should secure access to the subsoil water as quickly as possible. Reference is also made to the recent experiments of Dr. Saunders and others on the breeding of wheat in order to develop "strength," heavy cropping power, early maturity, and resistance to rust and drought. The work to be done here is very extensive, as different localities demand widely different types, owing both to economic and to physical differences. Even in a given locality the results obtained vary greatly according to the conditions, a "strong" wheat often giving a crop of weak piebald wheat when grown on newly broken land, whilst on old land the crop may be superior in quality to that used as seed, a difference that is perhaps due to the great decrease in the proportion of water in the older land during the period of growth of the crop. It is pointed out that continuous cropping with wheat appears to break down the fertility of the soil by bacterial changes, which result in disintegrating the nitrogen, rather than by chemical exhaustion; the soil recovers, however, when planted with clover and similar crops, which act as agents for the fixation of nitrogen; as this seems to fit in with the natural development of farming in a new country, the temporary loss of fertility is of less importance than might appear at first sight to be the case.

BOTANY AT THE BRITISH ASSOCIATION.

The President's Address.

IN accordance with the custom that is growing up of arranging for a minimum of clashing between the various presidential addresses, Prof. Trail delivered his address (which was printed in full in NATURE of October 6) at 12 noon on Thursday, September 1. The address dealt with the subject of field botany, and the president particularly urged the need for the preparation of a really great national flora. As a direct outcome of the address, a committee was subsequently appointed, with Dr. Trail as chairman, to consider what steps should be taken towards organising and preparing the materials for such a flora.

As regards the rest of the proceedings, the outstanding features of the Sheffield meeting were the sittings devoted respectively to physiology, cytology, and morphology. Judged by the keenness of the discussions and the numbers attending the section, the meeting must be pronounced to have been distinctly better than the average. It will be convenient to deal first with the subject of physiology.

Physiology.

On Monday morning, September 5, there was a joint sitting of the botanists, chemists, and physiologists in the meeting-room of Section K, the subject being the biochemistry of respiration. A report of this discussion will be found in the account of the proceedings of Section I (p. 26), so it is unnecessary here to do more than mention the botanical contributions to the discussion. Dr. F. F. Blackman, who opened the subject, by way of introduction outlined our present knowledge of the respiration of plants in respect to:—(1) the nature of the reaction (or reactions) which constitutes respiration; (2) the physical chemistry of the respiration reaction; and (3) the influence of protoplasm upon the progress of the reaction. Mr. D. Thoday dealt with the effect of chloroform on the respiration of plants.

Tuesday morning, and to some extent Wednesday, were also devoted to physiological papers. Mr. S. Mangham read an interesting paper on the paths of translocation of sugars from green leaves. Using Senft's method of testing for sugars by the precipitation of osazones, the author was able to obtain definite evidence that the sieve-tubes (and not the parenchymatous vein sheaths) provide the main paths for the translocation of free sugars from the lamina of the leaf. He was thus able to confirm Czapek's theory, which had been disputed by Haberlandt and others. Mr. D. Thoday followed, and discussed assimilation and translocation under natural conditions. His experiments show that in detached leaves the increase of dry weight, due to assimilation, is surprisingly small in bright diffuse light as compared with bright sunlight. Leaves still attached to the plant show a smaller rate of increase than detached leaves; this is probably largely due to translocation. Dr. F. Darwin demonstrated a new method of observing in living leaves, while still attached to the plant, the degree to which the stomatal apertures are open or closed. The instrument (which he calls a *porometer*) consists of a small glass chamber cemented on to the stomatal surface of a leaf, and connected with a suction tube and manometer. By diminishing the air-pressure in the chamber a flow of air through the stomata is induced, the rate of flow indicating the condition of the stomatal apertures. Dr. Darwin then discussed some actual results obtained by the porometer. On comparing the readings of the latter with the loss of weight by transpiration, it was found that the two curves rise and fall together, but the transpiration readings have a much smaller range than those of the porometer. This is perhaps what might have been expected, taking into account Dr. Horace Brown's work on diffusion.

Miss N. Darwin and Dr. F. F. Blackman contributed a paper on germination conditions and the vitality of seeds. If the vitality of seeds is lowered by exposure to, *e.g.*, high temperatures, they do not germinate well, and become more sensitive to any unfavourable modification of the environment. Failure to germinate when too little water is present is due to purely physical causes, while the injurious effects of excess of water are due to the water acting as an oxygen excluder. Mr. A. S. Horne next discussed the absorption of water by various leguminous seeds. Prof. Bottomley showed that the Cyanophyceæ endophytic in the apogeotropic roots of cycads and in the cavities of Azolla and Anthoceros are invariably accompanied by nitrogen-fixing bacteria. He suggested that this may really be a symbiotic association of the algæ and the bacteria.

Ecology.

In contrast to the Winnipeg meeting, ecology was represented this year by only two papers. Mr. J. H. Priestley gave an account of the distribution of halophytes on the Severn shore. In this district the halophytes exhibit three well-marked zones:—(1) the low-lying Salicornia zone; (2) the Sclerochloa and Aster zone; and (3) the rarely submerged *Juncus Gerardi* and *Festuca rubra* zone. Apparent anomalies of distribution are probably referable to differences of drainage and salinity. Mr. M. Wilson discussed plant distribution in the woods of north-east Kent.

Cytological Papers, &c.

Friday morning was occupied with papers dealing with cytology and heredity, the first two being taken jointly with Section D (Zoology). In a paper entitled "The New Force, Mitokinetism," Prof. Marcus Hartog further developed his views on the formation of the spindle and other structures observed during karyokinesis. Discussing the various theories put forward, Prof. Hartog contended that neither diffusion currents on one hand, nor electrolytic or electrostatic force or magnetism on the other, are sufficient to account for the formation of the mitotic spindle. As an alternative the author postulates the existence of a new force, which he terms "mitokinetism," and which, so far, is unknown outside the living cell. Dr. E. Hindle followed with an account of artificial parthenogenesis in the eggs of a sea-urchin (*Strongylocentrotus purpuratus*). The author described the process of artificial fertilisation in these eggs by treatment with a monobasic fatty acid, and subsequently with hypertonic salt solution. The cytological changes undergone were carefully described, including the formation of an artificial fertilisation membrane and the various nuclear changes. Under suitable conditions free-swimming larvæ were produced. These, though their dividing nuclei contained only the reduced number of chromosomes, were identical in form and behaviour with those developed from normally fertilised eggs. This concluded the joint sitting of Sections D and K, and the remaining papers were communicated to Section K alone.

The next two papers dealt with the behaviour of the chromosomes during mitosis, and particularly with respect to the stage at which longitudinal fission is initiated. Prof. Farmer and Miss Digby found in Galtonia that during the archesporial divisions the longitudinal fission begins by a condensation of the chromatin on the edges of the chromosomes during the telophase of the preceding division, and the duplicate character can thus be detected very early. Similarly, in the heterotype division of mitosis, the longitudinal fission is prepared for, as in the somatic mitoses, during the telophase of the last archesporial division. Dr. Fraser and Mr. Snell obtained very similar results in *Vicia faba*. They found that the chromosomes which are separated from each other in any given division are the product of a longitudinal fission which is initiated in the preceding telophase. This was stated to be the case in both the sporophyte and gametophyte generations, the resting chromosomes in both cases exhibiting a double structure. Prof. V. H. Blackman, in a very interesting short paper, described the vermiform male nuclei of Lilium. The author brought forward evidence that, although purely nuclear in structure and possessing no cilia, these structures are capable of active movement. It seems probable that the activity of these nuclei, and not the streaming movements of the surrounding cytoplasm, is responsible for their entrance into the ovum and passage to the polar nuclei.

The remaining two papers taken on Friday dealt with problems of heredity. Mr. R. P. Gregory offered some further observations on inheritance in *Primula sinensis.*

and Prof. F. E. Weiss described some experiments on the inheritance of colour in the pimpernel. The latter author crossed *Anagallis arvensis* and *A. coerulea* (the red and blue pimpernels). The red colour proved to be dominant, while in the f_2 generation there was complete segregation into red and blue forms. This is another interesting case of a recessive blue in the Primulaceæ.

Fungi.

The fungal papers were taken on Thursday morning before the president's address. Prof. Buller discussed the function and fate of the cystidia of Coprinus. The author confirmed Brefeld's view that the cystidia act as props to keep the gills from touching each other. He pointed out that this is necessary to allow for the free escape of the ripe spores. The cystidia themselves disappear by a process of autodigestion just before the basidia in their immediate neighbourhood are ready to discharge their spores. In the discussion on this paper Mr. Wager suggested that the cystidium must be regarded as having been phylogenetically derived from the basidium. Mr. A. E. Lechmere read an interesting paper on the methods of asexual reproduction in a species of Saprolegnia. In hanging-drop cultures great variation was found in the behaviour of the zoospores, the method of discharge, and the shape of the sporocyst. Variations of form, &c., supposed to be characteristic of distinct genera of the Saprolegnieæ were found within the limits of this single species. Prof. V. H. Blackman described a form of nuclear division intermediate between mitosis and amitosis in *Coleosporium Tussilaginis*. A spindle is formed on which granular chromatin collects, and is then drawn apart towards the poles. The chromatin is not aggregated into definite chromosomes. Mr. Harold Wager, in a paper on chromosome reduction in the Hymenomycetes, maintained that normally only two nuclei (each containing four chromosomes) fuse in the basidium. During the division of the fusion nucleus the spireme breaks up into eight chromosomes, reduction being brought about in a simple manner by the distribution of the chromosomes to the two daughter nuclei. Mr. F. T. Brooks described his investigations into the cause of the silver-leaf disease of fruit trees. These experiments are still proceeding, but, although not absolutely proved, the available evidence points, as previously suggested by Percival and Pickering, to *Stereum purpureum* as the probable cause of the disease.

Morphological and other Papers.

Although only an afternoon session (on Monday) was available for morphology, the papers proved so attractive that the section sat for nearly three and a half hours. Prof. F. O. Bower led off with two papers. The first was a short note on *Ophioglossum palmatum*. The divided character of the leaf-trace supports the conclusion, previously arrived at from its external morphology, that *O. palmatum* is one of the more extreme and specialised types of the Ophioglossaceæ. The second paper, on two synthetic genera of Filicales, dealt with some very interesting problems of phylogeny. The two genera in question are Plagiogyria (formerly included in Lomaria) and Lophosoria (usually grouped with Alsophila). The author not only put forward strong reasons why these respective genera should be kept separate, but suggested that both are probably important intermediate synthetic forms. Thus he regards Plagiogyria as a transitional form related on the one hand to the Gleicheniaceæ and the Schizæaceæ, and on the other to the whole series of Pterideæ. Similarly in the case of Lophosoria, a probable sequence may be traced from forms also having affinities with the Gleicheniaceæ through Lophosoria to Alsophila and other Cyatheaceæ.

Dr. Kidston and Prof. Gwynne-Vaughan described the structure of the "false stems" of the fossil genus Tempskya. This plant had an extraordinary habit. Its erect "stem," which grew to a height of 9 or more feet, really consisted of an aggregate of branching stems embedded in a compact mass of their own adventitious roots. The individual stems were slender, and possessed a dorsi-ventral symmetry. The authors think that in this case the erect habit had been only recently acquired, the particular method adopted being one which could be evolved with great rapidity. They further suggest that the erect habit of modern tree-ferns may be a secondary character derived from Tempskya-like forms, in which the original axis has developed at the expense of the lateral branches. Dr. M. C. Stopes read a paper in which she further described the fossil flower *Cretovarium japonicum*, dealing especially with the structure of the ovary. Mrs. Thoday, in a communication on the morphology of the ovule of *Gnetum africanum*, instituted a comparison between this and the ovules of Welwitschia and Lagenostoma. She regards the ovule of Gnetum as probably more primitive than that of Welwitschia on account of its radial structure, the presence in the young ovule of a well-developed pollen chamber, and the small development of the free portion of the nucellus. Prof. F. W. Oliver next discussed the pollen chambers of various fossil seeds. He showed that in certain seeds (*e.g.* Conostoma spp.) the structure of the nucellar apex is much more complex than in forms such as Lagenostoma, &c. In these more complicated forms a second pollen chamber was excavated below the primary one (which alone is found in Lagenostoma), the latter becoming merely vestigial. In the light of this discovery it seems possible that the nucellar beak of Trigonocarpus, Ginkgo, &c., may represent a vestigial primary pollen chamber, which had been functionally replaced by a more deeply seated cavity.

Prof. W. H. Lang concluded the afternoon's sitting with a very interesting account of the morphology of the stock of Isoetes. He produced evidence that the stock grows regularly in two opposite directions. Leaves are produced at the upper end, the stem apex being situated at the base of a deep depression. Similarly, the roots are borne in regular sequence on a downwardly growing region. In this case, too, the apex is at the bottom of a deep depression, but the growing point is obscured by the congenital union of the sides of the depression. The young roots are finally freed by the gradual and partial separation of the united lobes of the stock. Although greatly modified, the axis of Isoetes is strictly comparable with that of Lepidodendron or Pleuromeia.

The Semi-popular Lecture

this year was given by Prof. F. O. Bower, the subject being "Sand-dunes and Golf Links." The lecture, which was greatly appreciated, dealt chiefly with the part played by vegetation in the formation and fixing of sand-dunes. Perhaps the prominence given to this part of the subject caused some mild disappointment to the golfers present, who wished for practical hints on the keeping of greens. Prof. Bower showed a number of beautiful photographs, amongst the most interesting being some of shifting dunes.

ENGINEERING AND CIVILISATION.[1]

IN order rightly to appreciate the share taken by our profession in bringing about the present state of civilisation, a comparison should be made between the conditions prevailing, say, in the Greek states during the fifth and fourth centuries before Christ and those existing now in the twentieth century after Christ.

In indicating the state of knowledge at that period of Greek history, it is enough to remind you that it was the age of Themistocles, Aristides, and Pericles, the statesmen; of Æschylus, Sophocles, Euripides, and Aristophanes, the dramatists; of Phidias, Scopas, and Praxiteles, the sculptors; of Apollodorus, Zeuxis, and Apelles, the painters; of Ictinus, the chief designer of the Parthenon, and Dinocrates, who rebuilt the temple of Diana at Ephesus and laid out the city of Alexandria, the architects; of Herodotus, Thucydides, and Xenophon, the historians; of Socrates, Plato, and Aristotle, the philosophers.

Can we say that there have been many since that time who are worthy to be mentioned as equals of the men I have just named? The fact alone that we use the adjective "classical" to indicate perfection in literature and art shows what a standing had been attained more than 2000 years ago, and in many respects we feel down

[1] From the Presidential Address delivered at the Institution of Civil Engineers on November 1, by Mr. Alexander Siemens.

to the present time the direct influence of Greek and Roman learning.

In his "Organon" Aristotle expounded the logic of deductive reasoning in such a complete form that even the terms which he was the first to establish are in use at the present time, and both Kant and Hegel acknowledged that from the time of Aristotle logic had made no progress. But the schoolmen did not realise that the "Organon" was merely an "instrument" setting out the theory of reasoning; they neglected altogether the teaching of Aristotle, that in every branch of science or art the only means of obtaining premises on which logical deductions can be based is by experience and observation of facts. He says in the "Prior Analytics," I., xxx., 3:—"When the facts in each branch are brought together it will be the province of the logician to set out the demonstrations in a manner clear and fit for use."

This principle of bringing together facts was absolutely neglected in mediæval times by the later schoolmen, even when, during the thirteenth century, the complete works of Aristotle, translated into Latin, had become known to them, although at first the Church authorities would not allow any lectures to be delivered on them in the universities.

A reaction against Scholasticism, or Obscurantism as it is sometimes called, set in during the fifteenth century; it was strongly supported by the Reformation, but it is the merit of Sir Francis Bacon to have directed the course of the further studies of mankind into the right channel by showing that the object of all science is to recover man's sovereignty over nature, or, as he expresses it, "to extend more widely the limits of the power and of the greatness of man" ("Novum Organum," I., 116).

For this purpose, Bacon asserts, it is necessary to study nature by inductive investigation after observing and collecting facts, but, in contrast to the deductive reasoning adopted by the schoolmen, he lays down that "the induction that is to be available for the discovery and demonstration of sciences and arts must analyse nature by proper rejections and exclusions, and then, after a sufficient number of negatives, come to a conclusion on the affirmative instances, which has not yet been done save only by Plato . . . and this induction must be used not only to discover axioms, but also in the formation of notions" ("Novum Organum," I., 105).

Although it cannot be said that the Baconian method has been followed in its entirety during the subsequent development of science, its fundamental ideas, viz. the need for rejecting rash generalisation and the necessity for critical analysis of experience, serve as the sound basis of the modern method of framing hypotheses and verifying them by observation and experiment.

In literature and art or in philosophy we cannot boast of being greatly superior to the ancients, but, so far as engineering problems are concerned, we have enormously advanced, thanks to the practical application of scientific theories.

Comparing generally the conditions of life then and now, we may sum up the difference by claiming that our progress is due principally:—(1) to the improvement of the means of communication; (2) to the saving of manual labour by the introduction of mechanical power; which main features have caused a general lowering of the cost of "obtainables."

When Hertz discovered the property of electric sparks to start waves of the æther which can be detected at a distance, nobody anticipated that Marconi and others would succeed in developing these small beginnings to the system of wireless telegraphy, of which nowadays so many applications are in constant use.

Again, the polyphase motors and generators of electricity had their beginning in the researches of Prof. Ferraris, who demonstrated that three alternate currents can be combined in such a manner that the sum of the three currents at any moment is equal to zero, and that by their aid a revolving magnetic field is produced.

When we seek to recognise true progress in the material conditions under which we are living, it is not unreasonable to expect that any further advance will be made on the same lines as differentiate our present civilisation from that of the ancients, and that "lowering the cost of obtainables," based upon improvement of communications and upon the saving of manual labour, will furnish a trustworthy test whether a change suggested to be made in our material surroundings is worth adopting or is merely an alternative without any prospect of being generally accepted.

The development of the manufacture of glow-lamps is a striking example of the advantage of labour-saving machinery; at first the lamps were made by a few skilled workers at a high cost, so that they could not be sold for less than twenty-five shillings each. This excessive cost naturally restricted their sale; but the efforts of the manufacturers to devise labour-saving machinery were not relaxed until the selling price of glow-lamps had diminished to its present level, when they are sold by the million. Can anybody doubt that the introduction of labour-saving machinery into this industry, far from diminishing opportunities for employment, has not only benefited the skilled workers, but has opened new avenues for profitable employment to the so-called unskilled labour.

Nor is the advantage limited to this particular industry; the possibility of obtaining cheap glow-lamps has increased the sale of dynamos, steam and gas engines, cables and fittings, giving employment to thousands of workmen. Similar consequences have followed the introduction of labour-saving machinery into other branches of manufacture.

In their own interest inventors should appreciate more than they have done in the past that progress is not the result of flashes of genius that illuminate suddenly a hitherto unknown subject, but that it can only be gained by plodding work and careful study directed by an infinite capacity for taking pains.

This requirement is expressed very tersely by Aristotle in his definitions of science and of art, which, unfortunately, have been lost sight of in the course of ages, so that they cannot be used any longer. They are, however, so appropriate to our subject that I do not hesitate to repeat them.

Aristotle says:—Science is the trained faculty of demonstrating necessary conclusions from necessary premises, and these conclusions are independent of the producer.

Art is the trained faculty of producing, involving sound reasoning; it has to do with the genesis, the production of things, and the result depends on the producer.

From these definitions it follows that every profession requires to have its "science" which teaches the "sound reasoning" on which its "art" is based, and for both "science" and "art" training is a necessary condition for success.

They indicate, to my mind, for our profession in particular, that the college teaching should occupy itself principally, though not exclusively, with "science," viz. the natural laws which are "independent of the producer," leaving the "art" of engineering to be developed by practical work either in the field, in the drawing office, or in the workshop.

So far as the "science" of any industry is concerned, all civilised countries have access to the results of the latest researches which are published without loss of time in the technical journals, and the "art" of each industry devotes itself everywhere to the problem of lowering the cost of production in order to widen the circle of possible customers.

Viewing the question of international competition from this aspect, it can only be regarded as an extension of the competition at home, and, applying the same reasoning, the question naturally arises whether it would be desirable to have international standards or not. Looked at from the point of view of the consumer, it certainly appears to be very convenient to be able to obtain supplies from a number of different sources with the certainty of their being interchangeable, or at least equivalent.

In fact, the same reasons that have led to the establishment of the Engineering Standards Committee in this country hold good for international dealings, so that we may look forward to the time when international standard specifications will be accepted all over the world. A beginning was made when the British Association introduced in 1861 the C.G.S. system of electrical units, which, since that time, have been adopted internationally, and a further step was taken at the St. Louis Exhibition of

1904, when the International Electro-technical Commission was called into being.

It is a very significant circumstance that it has been found necessary for this commission to associate itself in some branches of its activity with the Engineering Standards Committee, and it is not unreasonable to expect that such joint international action will gradually extend beyond the field of electricity.

FORESTRY EDUCATION: ITS IMPORTANCE AND REQUIREMENTS.[1]

I PROPOSE to deal to-day with a brief exposition of the points on which the system of forestry education is based. It will be of interest, I think, first to glance briefly at the training to be obtained at some of the European forestry schools, and the facilities provided for giving it. We will then consider some of the things the student in forestry must know, and in this connection glance briefly at a few of the duties which confront the forest officer in the course of his ordinary work in India, concluding, finally, with a review of the present position of the university as regards forestry training and the steps which require to be taken to enable us to send out the class of British forester which is already required in many of our colonies, and for which we trust there will soon be a demand in the British Isles.

A few years ago, whilst on furlough from India, I made a tour of some of the forestry colleges and schools of Europe, my object being to study the lines upon which the Continental system of education was based and the methods they adopted to combine a proper proportion of practical work with the theoretical instruction given in the class-room. In the course of my tour I visited Eberswalde, Tharandt, Aschaffenburg, and Munich Forestry Schools in Germany, the Imperial Forestry Institute at St. Petersburg, the Agricultural and Forestry Institute at Vienna, and the fine French Forest School at Nancy. That tour was an education in itself. Briefly, I may sum up the results of my observations as to the essentials for the tuition of forestry thus:—(1) a strong teaching staff; (2) good museums; (3) a forest garden and forest educational woods.

(1) *The Instructional Staff.*—The study of forestry so depends on a number of cognate subjects, such as botany, chemistry, geology, zoology, surveying, and forest engineering, &c., that it is essential that the student should be given first-class courses in these matters. Excellent courses are given in all the Continental colleges. There remains the subject of forestry itself, comprising the various branches of silviculture, forest management, forest valuation, forest protection, forest utilisation, the law of the forests, and procedure and accounts. To lecture on these various branches, the best Continental colleges retain the services of at least three men, professors and assistants, many of the former having world-wide reputations in their various branches. These men are also often responsible for their own departments of work in the school forest garden and instructional forests. Their work, as we shall see, falls under two heads. They deliver courses of lectures in the lecture hall, and they conduct the students on the excursions made into the woods to illustrate these lectures, and personally supervise every piece of practical work laid down for the student to do. Since the minimum time in which a student can finish the forestry course is two years, the professor requires at least one assistant to conduct a part of the lectures, for the junior and senior students are both necessarily attending courses at the same time, and one lot may be in the woods whilst the other is in the lecture hall. At the well-known Forestry School at Munich, the home of a number of famous foresters, the various branches of forestry science are in charge of three professors: Prof. Mayer takes silviculture, forest utilisation, protection, and foreign forestry; Prof. Endres, forest policy, administration, valuation, and finance; whilst Prof. Schüffer lectures in forest management and working plans, estimation of increment, and yield. Each of the professors is responsible for the excursions, laboratory and practical work, of their various courses.

(2) *Good Museums.*—The educational value of a good museum is fully recognised. It need not be enlarged upon here. Forestry is peculiarly a science the tuition of which on the one side and assimilation on the other is dependent upon two essentials, a thoroughly efficient system of practical work, and up-to-date, well-planned museums exhibiting in a simple and efficient manner the various details connected with forest work.

So important is the museum as an adjunct to the efficient teaching of forestry that we find in all the Continental forestry colleges that considerable sums of money have been spent on this part of the equipment alone, and yet in some instances, although with treble the space available here in Edinburgh, the cry was often that more room was required. Where all is so good it is difficult to particularise, but as examples of efficiency in this respect I will instance the museums at the Forestry School of Nancy in France, the Imperial Forestry Institute in St. Petersburg, and the Forestry College at the University of Munich. The latter, so far as its building accommodation and museums are concerned, forms the nearest parallel to the position of Edinburgh University, and it will be of interest to glance briefly at the accommodation provided.

The Forestry College at Munich forms part of the University of the town and State, and considerable sums of money were spent a few years ago with the object of bringing it thoroughly up-to-date. The buildings devoted to forestry instruction are two in number, both situated in the grounds of the University.

The new building, which was opened about the year 1900, is the most perfect institution of its kind that man could have devised. The whole of the inside fittings are of wood, highly polished parquet flooring being used throughout, whilst the rooms are handsomely panelled with various kinds of woods. The chemical, mineralogical, meteorological laboratories, &c., are in the basement; forest surveying, mathematics, and forest-wood museums on the first floor; and forest implements, forest products, and models and diseases of woods on the next floor. Each of these branches or departments of science has its own museums, one or two rooms as are required, its own large lecture hall, with professors' and assistants' rooms, laboratories where required, packer's room, &c.

The space devoted to forestry pure and simple is ample, no fewer than five large rooms and halls being devoted to the exhibition of the collections alone, those of each branch being exhibited alone.

This brief description will show that there is little fault to be found with the arrangements and space devoted to this wonderfully efficient forestry college. With such equipment there is every incentive to professor and student alike, not only to work, but to undertake research work in the various branches of forestry. In the Bavarian University the State pays for the upkeep of the major portion of the Forestry Department, and in return the Government reaps the advantages derived from the very important research work and experimental work in which its professors, many with great European reputations, spend all their spare time.

(3) *The Forest Garden and Educational Woods.*—We come now to our third essential to the proper teaching of forestry, the forest garden and educational woods. It may be said at once that the subject of forestry cannot be taught by the professor or assimilated by the student unless efficient instructional woods are available to which the student can be taken during the lecture course, as well as during the practical course, to be shown eye object-lessons of what he is told. He should be shown in the woods what he is told in the lecture-room, and taught to observe for himself—that first and most important of the lessons of a forester. These first principles of the education of a forestry student are well understood on the Continent, and are adequately provided for.

I will give two instances out of many. The German Forestry Academy of Tharandt is situated not far from Dresden, in Saxony. The school is provided with a forest garden and demonstration forest, forming a compact block in its immediate vicinity. The forest garden is situated on a hill-side immediately behind the school. The hill-

[1] From the inaugural lecture delivered at the University of Edinburgh on October 12, by Mr. E. P. Stebbing, Head of the Forestry Department of the University.

side is terraced into beds, which contain some 1800 different species of trees, shrubs, perennials, and annuals of various kinds, both indigenous and exotic. This garden serves as a forestry and botanical garden, and is an exceptionally fine one, covering an area of about 18 hectares. There is a forest nursery in the garden managed on most up-to-date lines.

The school demonstration forests adjoin the forest garden, and are kept up entirely for educational and demonstration purposes. They are situated in a hilly area presenting ever-varying conditions, aspects, and variations in soil, thus allowing of a variety of object-lessons with different species and mixtures being presented to the student. For example, these woods contain spruce and beech with birch in mixture; spruce and silver fir, or the two latter with birch. Or again, there are woods of spruce, beech, Scotch pine, silver fir, larch, maple, birch with maple and various mixtures, ash (pure, about thirty years old), alder (in wet valleys), oak, and a little Æsculus. There are some most interesting mixtures to be seen doing remarkably well, and forming an ideal of what demonstration woods should be. The steep slopes of the hill-sides are worked under different sylvicultural systems to the area of tableland above, where the woods are clear-cut and naturally regenerated or sown or planted. Exotics are being largely introduced, and thousands of plants are sent out annually from the forest garden and nursery in the demonstration area into the forests all over Saxony. Fencing of young planted areas and other ways of protecting young plants from deer, &c., are to be seen in practice in the woods. Time will not permit of my dwelling upon this excellent educational demonstration area; but from his earliest course in the lecture-room the student is taken out week by week into the forest garden or woods, and with his own hands learns how to trench, sow, plant, thin, and fell and measure up his woods; is taught to distinguish the different species of tree, and how they differ in their requirements of soil, light, moisture, &c.; is shown on what the foundations of sylviculture depend; and is gradually led, step by step and stage by stage, to understand and grasp both the theory and practice of the various branches of the lore of the woods comprised in forestry.

I should like to give another instance of this educational forest. The Imperial Institute of Forestry at St. Petersburg is probably the largest forestry college in Europe. The students number 500, all training for the controlling staff. In addition, there are thirty-three lower-grade schools containing fifteen students apiece, from which the ranks of the forest rangers and upper guards are filled. Attached to the institute at St. Petersburg are two educational forests, the one 14 versts (9 miles) from the capital, the other, and larger, 60 versts (40 miles) away. At each of them buildings are maintained for housing the professors and students during their visits. Portions of every summer are spent by the students in these woods occupied in practical work. The woods are entirely under the management of the director of the college, as is the case at Tharandt, and are managed on similar lines, and solely for demonstration purposes. The directors at both these places, as also the forestry professors (and this applies to many of the Continental colleges), are all practical men who have themselves been through the mill of executive work, have themselves held charge of large areas of woods worked entirely on a commercial basis, and are therefore in a position to see that the instruction given to the students is such as will return full value to the State or proprietor who employs the men leaving their institutions.

This is a point which I think worthy of the most serious consideration in this country. Too great stress cannot be laid on what are, after all, actual facts. The excellent and remunerative results of forestry in Europe, which we also wish to arrive at in the British Isles, are solely the result of the study of higher forestry both in the woods and in the laboratory. Practical foresters can only be successful in proportion to the knowledge they themselves possess or which is imparted to them by those who know. We can learn from other countries a great deal, but the application of what we learn must depend on ourselves and must be carried out by ourselves.

We have now seen what the Continental forestry colleges consider the essentials to the proper tuition of forestry as a science, and have shown how the student is gradually led, not only to assimilate the theoretical portions of the study in the lecture-room, but to take with him what he has absorbed there and apply it practically in the woods. We have seen that these practical object-lessons must begin with the student's first lectures, that he must be taken into the woods at the beginning and be shown, step by step, that what he is being told in the lecture-room is not so much matter to be studied for an examination and to be subsequently forgotten when his text-books and note-books are thrown aside after the "pass" has been gained. It has been said of the forester that he is always at school, from the moment he first enters the lecture-room to commence his first course to the end of his life; and those of us who are foresters know this to be true. Our text-books and lecture notes remain our trusted friends to the end, and as we grow older and have had a more extensive practice and experience in forestry we grow more diffident about expressing definite opinions and laying down the law on the subject of the life-histories of our friends the trees. For the tree is very much like the human being. He has his wants and requirements, his fancies for particular aspects and localities, for certain soils and degrees of light, moisture, heat, and shade.

All these the forester must know and study, and even then his fastidious friend will often discover something he dislikes, and refuses to grow. The forester has to set to work to find out what this something is, and meanwhile all he has done is a failure—a failure, that is, unless he is a thoroughly trained scientific man. As such he will turn his failures to account, for he will place them on record so that he and others like him may set to work to get at the reasons for the failure of a crop which, so far as human forethought was capable of doing, had been given every chance. How much sound practical knowledge and observations have been lost to the foresters all over the world by this regrettable neglect to place upon record their failures. Almost more valuable are they to record than the successes; to the forester far more valuable. This is one of the spots upon which the scientific forester can place a finger in the British Isles. Had one a full, or even a partial, record of all the failures of the past, how much simpler would be the task at present facing the nation of getting its forestry house in order.

Scotland is more favourably situated and in a better position as regards woods of a high educational value than any other portion of the British Isles for undertaking this necessary research work. There are woods in Scotland, many of them known by repute, others less well known, in which the student on his practical course can learn a great deal and in which work of high importance to afforestation in the British Isles can be carried on. Edinburgh is very favourably situated for participating in this pioneer work, and has every intention of taking her share in it.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—To-day, November 10, Graces will be offered to the Senate proposing that the offer of the Worshipful Company of Drapers to erect a new physiological laboratory at Cambridge be gratefully accepted, subject to the conditions set forth in the letter, dated February 11, 1910, from the clerk to the company; that a syndicate be appointed to discuss details with the company; and that the Vice-Chancellor be authorised to convey to the court of assistants of the company the grateful thanks of the university for their munificent benefaction. Further, that the Vice-Chancellor, Dr. Mason, Master of Pembroke College; Mr. Shipley, Master of Christ's College; Dr. Langley, professor of physiology; Dr. W. M. Fletcher, and K. Lucas, of Trinity College, be the syndicate appointed under the above-mentioned Grace.

Applications for the tenure of the Benn W. Levy studentship in bio-chemistry should be sent to Mr. F. G. Hopkins, Trinity College, on or before Wednesday, November 30, 1910. Applicants should state their university standing and previous scientific experience, mentioning if they are in receipt of any other endowment for research. The studentship is open to members of the University of Cambridge who have been admitted to a degree, or to members of

Girton or Newnham Colleges who have acquitted themselves so as to have deserved honours and have fulfilled the conditions respecting length of residence which members of the university are required to fulfil before being admitted to a degree. The annual value of the studentship is 100*l*. The student, during his or her tenure of the studentship, shall prosecute original research in bio-chemistry, and shall not engage in such other work as in the opinion of those entrusted with the administration of the fund would seriously interfere with his or her original inquiries. The appointment will be for one or two years, at the option of the managers.

Notice is given that a prize of 50*l*. out of the Gordon-Wigan fund will be awarded at the end of the Easter term, 1911, for a research in chemistry, of sufficient merit, carried out in the University of Cambridge. Candidates for the prize must have taken Part I. of a Tripos examination, and be under the standing of M.A. The research may be in any branch of chemistry. The dissertation, with the details of the research, must be sent to the professor of chemistry not later than June 10, 1911.

The local examinations and lectures syndicate is about to appoint an assistant secretary for examinations. The person appointed will be expected to enter on his duties not later than January 1, 1911. The appointment will be made in the first instance for the period ending March 31, 1912, at a stipend of 400*l*. a year. The post will after that date be held during the pleasure of the syndicate, and the stipend will be raised by annual increments of 25*l*. to 500*l*. Graduates of the university who desire to offer themselves as candidates are requested to send their names to Dr. Keynes, Syndicate Buildings, so as to reach him not later than 9 a.m. on Monday, November 21.

The Vice-Chancellor gives notice, on behalf of the Board of Geographical Studies, that Mr. R. T. Günther has consented to deliver a lecture in Cambridge on Friday, November 11, at 5 p.m., on "Earth Movements of the Italian Coast." The lecture will be given in the Sedgwick Museum, and will be illustrated by lantern slides. Members of the University and others are invited.

The Regius professor of physic gives notice that Prof. Osler has consented to deliver a lecture on November 17, at 5 p.m., in the large theatre of the medical schools, on "Medical Education in France."

OXFORD.—The congregation of the University of Oxford had before it on November 8 the first of the important series of statutes framed by the Hebdomadal Council, in pursuance of the comprehensive scheme of reform initiated by the Chancellor, Viscount Curzon. The adoption of the statute, which deals with the constitution and powers of the boards of faculties, including that of mathematics and natural science, was advocated by the President of Magdalen, the Master of University College, and Prof. Geldart. Its provisions were sharply criticised by the Warden of All Souls and the Master of Balliol, and its rejection was recommended by Prof. Holland and the President of Corpus. The preamble was carried in a full house by a majority of rather more than two to one; but there is no doubt that strong efforts will be made to modify the effects of the statute by amendment, especially those of its provisions which deal with the composition of the electorate and with the control exercised by the University and colleges respectively over the subjects and methods of instruction.

The tenancy of the well-known house in Broad Street, long the residence of Sir Henry Acland, has lately been acquired for the Oxford School of Geography. When the necessary arrangements have been completed, the house will contain a library, reading-room, and collections of maps, views, and models. Part of the premises will be fitted up for the use of the Beit lecturer in colonial history (Mr. W. L. Grant), and accommodation will be provided for purposes of general geographical instruction and research. The whole will be under the direction of Prof. A. J. Herbertson. This much-needed development of the facilities for geographical studies in the University has been made possible by the generosity of Mr. Bailey, of Johannesburg, who has given 500*l*. towards the adaptation of the house, and has promised 250*l*. a year for five years towards its maintenance.

Mr. O. G. S. Crawford, of Keble College, has been appointed junior demonstrator in geography for one year.

Mr. G. C. Robson, formerly exhibitioner of New College, has been elected to the vacant Naples biological scholarship lately held by Mr. J. S. Huxley, of Balliol College.

Mr. Selwyn Image, of New College, who has recently delivered his inaugural lecture as Slade professor of fine art, is a well-known student of the microlepidoptera, and is at present a member of the council of the Entomological Society of London. The seal of the society, which is a work of great artistic merit, was designed by the new Slade professor.

To encourage further interest in the subject of oceanography, it has been decided to invite the members of Dr. Bruce's class in geography at the summer school at St. Andrews this year to write essays on certain aspects of oceanography, and to submit them at the end of next spring. The essays are to be on one or other of the following subjects:—(*a*) on the effects of wind, temperature, and salinity on the circulation of the ocean, or (*b*) on the question of continental connections. The competition is only open to members of Dr. Bruce's class, and the essays must be lodged with the director of studies on the last day of April, 1911. Two prizes will be awarded, viz. two sets of the report on "The Scientific Result of the Voyage of the s.y. *Scotia* during the Years 1902, 1903, 1904." The two successful essays will be published either by the Scottish Oceanographical Laboratory or in the *Scottish Geographical Magazine*.

THE *Electrical Review* in its issue of October 21 directs attention to the great falling off in attendance at the evening classes of our technical schools which occurs during the course of each winter session. It contrasts the eagerness of the prospective student in consulting the teachers as to his course, in buying the text-books, and in making all his arrangements for strenuous work during the forthcoming winter evenings, with his tired and weary look and his vain attempt to follow the explanations given by his class teacher three months later. For this change, sheer fatigue and inability to stand the strain of perpetual day and evening work are responsible, and the *Review* charges the evening-school authorities with attempting too much and demanding attendance on the part of students for four or five evenings per week. It points out that undue strain can only be prevented by a reduction of the evenings of attendance to two, or in exceptional cases to three, per week, and urges the authorities to take this step as a means of improving both day and evening work of the students who attend their evening classes.

THE DUKE OF CONNAUGHT on November 5 laid the foundation-stone of the new University Hall of the Cape University. The council of the University presented an address, in which the hope was expressed that the union now accomplished in South Africa would lead to the conversion of the present Cape University into a teaching university for the whole of South Africa, by incorporating existing institutions of higher education as constituent colleges, and by creating chairs for those subjects for which no single college could provide. In replying, the Duke of Connaught said he trusted that the funds necessary to convert the Cape University into a great teaching university would be forthcoming. At a university luncheon held on the same day, Mr. Malan, Union Minister of Education, announced that Mr. Otto Beit had agreed to divert the sum of 200,000*l*., bequeathed by the late Mr. Alfred Beit for the foundation of a university at Johannesburg, to the creation of a great teaching university at Groote Schuur, the estate of the late Mr. Cecil Rhodes outside Cape Town. It was also announced that Sir Julius Wernher has promised to make up the amount to a total of 500,000*l*.

A NEW engineering laboratory was opened at the Darlington Technical College on October 20 by the Hon. C. A. Parsons, F.R.S. During the course of his address Mr. Parsons said that in the early part of last century engineering was principally guided by traditional rule and trade knowledge, handed down from father to son and from master to apprentice. Engineering has gradually assumed a more important place, its field of operations has become wider and more complex, and it has become

imperative to institute, instead of the old and primitive methods, systematic technical training for young men. There is probably no field of work in modern times where so great an amount of well-ordered experimental investigation has been undertaken as in engineering. Referring to the advantages of engineering workshops, Mr. Parsons said that knowledge, more especially of the practical kind, must be acquired when a man is receptive, and at such an age when ideas and impressions become so ingrained as to constitute intuitive and guiding principles in after life. In the engineering laboratory students are brought face to face with materials and machinery for dealing with and discovering principles; they gradually acquire a familiarity with practical engineering and the power to think in engineering materials, and to form a mental picture when it is necessary to design a new or improve an old machine or to design new methods of work. Such a training fits a student to go out into the world with mind and eyes alert, ready to acquire more knowledge, and fit to command success in most branches of engineering. By the help of good technical training a much larger proportion of men of high standard are produced than formerly—men of knowledge capable of taking the lead and commanding, and able and willing to deal fairly with their subordinates.

THE executive council of the County Councils' Association has made a series of recommendations with regard to rural education. They follow the main lines of the proposals of the Departmental Committee on Agricultural Education, which reported two years ago. Among other plans, the council encourages the formation of separate agricultural committees appointed by the county education committees. Another proposal is to appoint, in consultation with the agricultural college with which the county may be associated, a resident agricultural instructor and adviser at a salary of not less than 500*l.* per annum, who shall be under the control of the county council. The duties of this officer will be to give courses of lectures during the winter months; to supervise experiments and demonstration plots; to visit farms, small holdings, or allotments, and advise as to the appearance of disease in crops, insect pests, and on other matters; to meet bodies of farmers at local exhibitions and shows for the purpose of discussion; to organise classes for instruction in farm labour subjects and prize competitions in connection with such subjects as hedging, ditching, and thatching; and to advise the committee as to the establishment of permanent centres for agricultural instruction. It is also suggested that each county should organise, with the aid of the agricultural adviser, developments of a semi-educational character in connection with cooperative small holdings, instruction in pig-breeding, the establishment of poultry societies for improving breed and management, the provision of instruction in bee-keeping, the establishment of demonstration small holdings, the provision of a central county garden with demonstration and experimental centres for horticulture, and the provision of a demonstration farm of 100 to 300 acres, which might be used later as the nucleus of a farm institute. The association estimates that 2000*l.* per annum will be needed as a commencement, and suggests that an application should be made for a grant of this amount. The association has adopted the view of the Departmental Committee that "agricultural education is of such vital importance to the United Kingdom that no effort should be spared in making the provision for it as full and complete as possible," and that a complete system of technical agricultural education is "the natural corollary to the vast sums spent on elementary education in the rural parts of the country."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 3.—Sir Archibald Geikie, K.C.B., president, in the chair.—Sir D. **Bruce** and others: (1) Trypanosome diseases of domestic animals in Uganda. II.—*Trypanosoma brucei* (Plimmer and Bradford). (2) Trypanosome diseases of domestic animals in Uganda. III.—*Trypanosoma vivax* (Ziemann).—H. G. **Plimmer**, W. B. **Fry**, and H. S. **Ranken**: Further results of the experimental treatment of trypanosomiasis: being a progress report to a committee of the Royal Society. This paper gives detailed results of the continuation of the work which has been going on under the direction of a subcommittee of the Royal Society. The general results have confirmed an opinion which the authors have before expressed, viz. that antimony is a more powerful trypanocide than arsenic, and that such compounds as they have tried have not shown such severe toxic effects as some arsenic compounds have. But there are unpleasant effects produced (varying according to the animal used) by antimony, such as sloughing and necrosis at the seat of injection and severe pain, so they have devoted considerable time to the study of new methods and new forms of antimony. Finding that in dogs the subcutaneous and intramuscular administration caused pain and sloughing of the tissues, intravenous injections of the salts were tried. The elimination of the antimony was so rapid, however, that, beyond prolonging life, little good effect was produced; so that eventually the injection of the metal itself, in state of finest division (devised and prepared for them by Dr. R. H. Aders Plimmer, of University College), was tried. This is taken up by the leucocytes, and is gradually transformed into some soluble compound, and their idea was that perchance it might be carried to parts of the body not easily accessible to other methods of administration. The results so far have been, on the whole, more satisfactory than those of any other means they have tried, but the technique in many animals is difficult, and there have been difficulties in the preparation of the antimony. Although putting a metal into the circulation sounds impossible, they have not had any case of plugging of capillaries in rats, guinea-pigs, rabbits, dogs, goats, or horses. It of course acts much more slowly than the salts, and takes from two to three times as long to clear the peripheral circulation of trypanosomes as subcutaneous injection of a salt does. But the excretion is also much slower, so that the blood and organs are in much longer contact with antimony than when a salt is administered. If carefully administered no irritation of the tissues is produced, and the vessel walls are not affected. Animals appear to be more susceptible to overdosage than with the salts; and it is curious that an animal with trypanosomes in the blood can bear well a dose which is fatal to a healthy animal. It has also been used intraperitoneally successfully in rats and rabbits. A number of experiments have been made with silver salts, with negative results in every case. A number of experiments have been made with two new compounds (one an arsenic-camphor compound, one an organic antimony compound) kindly sent to them by Dr. Morgan, of the Imperial College of Science, with negative results.—Dr. J. W. W. **Stephens** and Dr. H. B. **Fantham**: The peculiar morphology of a trypanosome from a case of sleeping sickness, and the possibility of its being a new species (*Trypanosoma rhodesiense*). The main points of the paper may be thus summarised:—(1) This trypanosome was first observed by one of the authors (J. W. W. S.) in February in the blood of a rat infected from a case of sleeping sickness. (2) The patient, W. A., infected in Rhodesia, had never been in *Glossina palpalis* areas, though he had been in areas infested with *G. morsitans* and *G. fusca*. (3) The trypanosome shows long forms and short stout or stumpy forms with hardly any free flagellum, *but it is unique in that about 6 per cent. of the forms have the nucleus at the posterior* (non-flagellar) end *near the blepharoplast, and in some cases actually posterior to it.* (4) Such forms have not been described before in any known strain of *T. gambiense*. (5) Prolonged search has been made for them in the stock laboratory strain of *T. gambiense*, but they have not been found. (6) They are not due to the drying of the blood films, because they can be seen by *intra vitam* staining, and because dried films of the ordinary *T. gambiense* strain do not show them. (7) They are not degenerate, as division forms of them occur. (8) They are not due to drug treatment, because the original animals were inoculated before treatment was begun. (9) These forms still persist in rats, guinea-pigs, rabbits, and monkeys. (10) On morphological grounds the authors believe they are dealing with a new species of human trypanosome also causing sleeping sickness, for which they propose the name *T. rhodesiense*.—Dr. F. W. **Mott**: Notes upon the

examination, with negative results, of the central nervous system in a case of cured human trypanosomiasis. A Sikh belonging to the 4th K.A.R. (aged thirty at death) was found to be suffering from trypanosomiasis in June, 1905, and received treatment with inorganic arsenic. The drug was given intermittently for eighteen months or more, and pushed until toxic symptoms of neuritis and mental dullness rendered further energetic treatment impossible; trypanosomes were then no longer obtained by puncture of the glands. Unfortunately, there is no note of lumbar puncture having been performed until a few months before death. Sir David Bruce, in December, 1908, saw this man, and stated that he appeared to be in excellent health. A year later he was seen by Captains Hamerton and Bateman, who reported no symptoms of sleeping sickness. They made a very careful investigation of the blood, both by microscopic examination and by experimental injection into monkeys; the results were negative. In June lumbar puncture was performed, and 17 c.c. of fluid withdrawn; the centrifuged fluid showed no lymphocytosis or trypanosomes; injection of the fluid into a monkey was followed by negative results. The patient was attacked with pneumonia in August, and died three days after admission to the hospital. *Post mortem* the brain was found quite normal in appearance, and there was no excess of fluid. *Histological Examination.*—Sections were prepared of portions of the cerebrum, cerebellum, and medulla oblongata by all the methods which the author had previously adopted for the examination of sleeping-sickness cases. He found no trace of the characteristic meningeal and perivascular infiltration nor of gliosis. It may therefore be asserted that this case proves that human trypanosomiasis is curable, but it does not prove that sleeping sickness is curable, for the author contends that the diagnosis of "sleeping sickness" can only be made when there is a proof that the trypanosomes had invaded the sub-arachnoid space. The tissues were forwarded to the author by C. A. Wiggins, the acting principal medical officer of Uganda.—Miss M. P. **Fitzgerald**: The origin of the hydrochloric acid in the gastric tubules.—Dr. A. **Harden** and R. V. **Norris**: The fermentation of galactose by yeast and yeast juice (preliminary communication).—W. M. **Thornton**: The opposite electrification produced by animal and vegetable life. —R. **Kirkpatrick**: A remarkable pharetronid sponge from Christmas Island.

Challenger Society, October 26.—Dr. A. E. Shipley in the chair.—Mr. **Earland** exhibited and made remarks upon *Pilulina jeffreysii*, a rare species of Foraminifera dredged west of St. Kilda by the *Goldseeker*, which had only been recorded once since its discovery by the *Porcupine* in 1869.—Mr. Tate **Regan** discussed the evolution of the flat-fishes, which he regarded as asymmetrical perches; from some form not unlike Psettodes, indifferently dextral or sinistral, had arisen two well-marked groups, and each of these had split into two series, a sinistral and a dextral. Parker's researches on the optic nerves had made it clear that reversal to the asymmetry of opposite sign was secondary in the Pleuronectidæ.

PARIS.

Academy of Sciences, October 31.—M. Émile Picard in the chair.—The president announced the loss by death of D. Gernez.—Henri **Douvillé**: Some cases of adaptation. The origin of man. A discussion of some modifications produced in various species by change in the conditions of life, including changes which may possibly have been produced in the anthropoid apes by lower temperature, reduced rainfall, and consequent destruction of forests.—M. **Coggia**: Observations of the new Cerulli planet (KU) 1910, made at the Observatory of Marseilles with the Eichens equatorial of 26 cm. aperture. Observations are given for October 21 and 22, and also the positions of the comparison star.—H. **Larose**: The extinction of the discontinuities by reflection at the extremities of a telegraphic line. In a previous paper the expressions for the potential and current on a telegraphic line of indefinite length were given; the case of a line of limited length is worked out in the present communication.—G. A. **Hemsalech**: The influence of the magnetic field on the duration of the lines of the spectrum emitted by luminous vapours in the electric spark. In a magnetic field the durations of nearly all the lines are diminished, and the intensity of the action on the different lines appears to be selective. Nearly all the lines diminish in intensity except in the immediate neighbourhood of the electrode.—Georges **Claude**: The preparation of argon. Compressed oxygen prepared by the fractional distillation of liquid air is now an article of commerce. If the proportion of oxygen is more than 95 per cent., as is always the case in practice, the chief impurity is argon, the volatility of which is intermediate between that of oxygen and that of nitrogen. Since the oxygen is very readily absorbed, such a mixture forms an advantageous starting point for the preparation of argon.—L. **Gay**: The osmotic equilibrium of two fluid phases.—M. **David**: A method of analysis of fatty bodies by the separation of the solid fatty acids from the liquid acids. This method is based on the fact that, at a temperature of 13° to 14° C., the ammoniacal salts of the solid fatty acids are absolutely insoluble in a large excess of ammonia, whilst the ammoniacal salts of the liquid acids are completely soluble. Results are given of the application of the method to the separation of stearic or palmitic acid from oleic acid.—G. **Darzens** and H. **Rost**: The synthesis of ketones in the tetrahydroaromatic series. Cyclohexene is treated with an acyl chloride in presence of aluminium chloride, and the product of the reaction heated with an excess of diethylaniline. The physical properties of four ketones prepared by this method are described.—Em. **Bourquelot** and M. **Bridel**: A new sugar, verbascose, extracted from the root of *Verbascum Thapsus*. The mode of extraction employed is given in detail. The new sugar is analogous to stachyose, of which it would appear to be an isomer and from which it differs by its higher melting point and its greater rotatory power; it gives levulose, glucose, and galactose on hydrolysis.—G. **Friedel** and F. **Grandjean**: Liquids with focal conics. Liquids of the group of ethyl azoxybenzoate are characterised by the existence of groups of focal conics in their mass or at their surface.—P. A. **Dangeard**: Two lower organisms met with in the Roscoff laboratory.—A. **Imbert**: The influence exerted by pain on the form of ergographic diagrams of fatigue. —H. **Truc** and C. **Fleig**: The experimental and chemical ocular action of bitumen dust and vapour. Bitumen dust can rapidly produce various lesions of the eye in man. The condition of the eye before exposure is an important predisposing cause, and the action of sunlight is also prejudicial. The lesions resulting from the action of bitumen vapour upon the eye are comparatively slight. —M. **Urbain**, Cl. **Scal**, and A. **Feige**: The sterilisation of water on the large scale by ultra-violet light. The water is caused to circulate spirally round a source of light in such a manner that with a flow of 20 cubic metres per hour the water is exposed for three minutes to the rays. With this device complete sterilisation of water has been obtained with an expenditure of twenty watts per cubic metre.—Ch. **Gravier**: The duration of life in the Madrapores.—Henry **Pénau**: The cytology of *Endomices albicans*.—Y. **Deprat**: The geographical distribution of the different layers recognised in Yun-nan (Geological expedition, 1909–10).—Julius **Schuster**: The geological age of the Pithecanthropus of the pluvial period in Java. From a study of the fossil plants collected from the Quaternary deposits of Lasem, Java, the author is able to confirm his earlier estimate of the age of Pithecanthropus. If with Penck the age of *Homo heidelbergensis* be taken as 300,000 years, Pithecanthropus lived at least 400,000 years ago.—Louis **Gentil**: Geological sketch of the massif of Kebdana (Eastern Morocco).—E. A. **Martel**: The chasms of the Pyrenees. A short description of seven groups of subterranean fissures, eighty-four in all, together with a discussion of their effect on the water supply of the district.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 10.

ROYAL SOCIETY, at 4.30.—The Tidal Observations of the British Antarctic Expedition, 1907: Sir George Darwin, K.C.B., F.R.S.—Conduction of Heat through Rarefied Gases: F. Soddy, F.R.S., and A. J. Berry.—The Chemical Physics involved in the Precipitation of Free Carbon from the Alloys of the Iron Carbon System: W. H. Hatfield.—A Spectroscopic Investigation of the Nature of the Carriers of Positive Electricity from

heated Aluminium Phosphate: Dr F. Horton.—On the Determination of the Tension of a recently-formed Water surface: N. Bohr.—Aërial Plane Waves of Finite Amplitude: Lord Rayleigh, O.M., F.R.S.—Observations on the Anomalous Behaviour of Delicate Balances, and an Account of Devices for increasing Accuracy in Weighings: I. J. Manley.—On the Improbability of a Random Distribution of the Stars in Space: Prof. F. W. Dyson, F.R.S.—The Conditions necessary for Discontinuous Motion in Gases: G. I. Taylor.—(1) On the Radium Content of Basalt; (2) Measurements of the Rate at which Helium is produced in Thorianite and Pitch-blende, with a Minimum Estimate of their Antiquity: The Hon. R. J. Strutt, F R.S.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting. — The Relation of Mathematics to Experimental Science (Presidential Address): Sir W. D. Niven.—Properties of Logarithmico-exponential Functions: G. H. Hardy.—The Double Six of Lines: G. T. Bennett.—On Semi-integrals and Oscillating Successions of Functions: Dr. W. H Young.—On the Existence of a Differential Coefficient: Dr. W. H. Young and Mrs. Young.—The Analytical Extension of Riemann's Zeta-function: F. Tavani.—The Geometrical Representation of non-real Points in space of Two and Three Dimensions: T. W. Chaundy.—The Extension of Tauber's Theorem: J. E. Littlewood.—A Note on the Property of being a Differential Coefficient: Dr. W. H. Young.—The Stability of Rotating Shafts: F. B. Pidduck.—A Class of Orthogonal Surfaces: J. E. Campbell.—On Non-integral Orders of Summability of Series and Integrals: S. Chapman.—Optical Geometry of Motion: A. A. Robb.—Lineo-linear Transformations, specially in Two Variables: Dr. A. R. Forsyth.—On the Conditions that a Trigonometrical Series should have the Fourier Form: Dr. W. H. Young.—Notes on Terminating Hyper-geometric Series: Dr. W. F. Sheppard.—The Transformation of a particular type of Electromagnetic Field and its Physical Interpretation: H. Bateman.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Inaugural Address of the President: S. Z. de Ferranti.

SOCIETY OF DYERS AND COLOURISTS, at 8.—A Comparison between the Action of Dyeing, Tanning, and Vulcanisation: W. P. Dreaper.

FRIDAY, NOVEMBER 11.

ROYAL ASTRONOMICAL SOCIETY, at 5.—On the Formulæ for comparison of Observed Phenomena of Jupiter's Satellites with Theory: W. de Sitter.—Photographs of Halley's Comet taken with the Astrographic Telescope at the Cordoba Observatory: C. D. Perrine.—Third note on the number of Faint Stars with large Proper Motions: H. H. Turner.—(1) Mean Areas and Heliographic Latitudes of Sun-spots in 1907, 1908, and 1909; (2) Observations of Minor Planets in 1909; (3) Observations of Jupiter's Eighth Satellite in 1910: Royal Observatory, Greenwich.—*Probable Papers*: Preliminary Comparison with Observation of the Tables of the Four great Satellites of Jupiter: R. A. Sampson.—(1) The Systematic Motions of the Stars of Boss's "Preliminary General Catalogue"; (2) Note on a Moving Cluster of Helium Stars in Perseus: A. S. Eddington.

MALACOLOGICAL SOCIETY, at 8.—On the names used by Bolten and Da Costa for genera of Venerdiæ: A. J. Jukes-Browne, F.R.S.—On New Melaniidæ from Goram and Kei Islands, Malay Archipelago: H. B. Preston.—On the Anatomy of the British Species of the Genus Psammobia: H. H. Bloomer.—Note on *Triton tesselatus*: Major A. J. Peile.

PHYSICAL SOCIETY, at 8.—On the supposed Propagation of Equatorial Magnetic Disturbances with Velocities of the Order of 100 miles per second: Dr. Chree, F.R.S.—On Cusped Waves of Light and the Theory of the Rainbow: Prof. W. B. Morton.—Exhibition of a Brightness Photometer: J. S. Dow.

TUESDAY, NOVEMBER 15.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Castes of Eastern Bengal (Epidiascope): Sir H. H. Risley, K.C.I.E., C.S.I.

ZOOLOGICAL SOCIETY, at 8.30.—On the Inheritance of the Webfoot Character in Pigeons: J. Lewis Bonhote.—Notes on the little-known Lizard *Lacerta jacksoni* Blgr., with special reference to its Cranial Characters: Edward Degen.—On *Lacerta peloponnesiaca* Bibr.: G. A. Boulenger, F.R.S.—Remarks on Two Species of Fishes of the Genus Gobius, from Observations made at Roscoff: Edward G. Boulenger.

ROYAL STATISTICAL SOCIETY, at 5.—Presidential Address on a Statistical Survey of the Problems of Pauperism: Lord George Hamilton, G.C.S.I.

MINERALOGICAL SOCIETY, at 5.30.—Anniversary Meeting.—Further Notes on Wood-tin: J. H. Collins.—On the Alteration of the Felspar of Granites to China-clay: J. M. Coon.—On Wiltshireite, a new Mineral from the Binnenthal: Prof. W. J. Lewis.—A new Locality of Phenakite in Cornwall: A. Russell.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Presidential Address on the Influence of Pure Science in Engineering: Sir J. J. Thomson, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: The London County Council Holborn to Strand Improvement, and Tramway-Subway: G. W. Humphreys.

WEDNESDAY, NOVEMBER 16.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Results of the Hourly Balloon Ascents made from Manchester, March 18th–19th, 1910: Miss Margaret White.—Registering Balloon Ascents, December 6th to 11th, 1909, and August 8th to 13th, 1910: W. H. Dines, F.R.S.—Pilot Balloon Observations in Barbados, December 6th to 11th, 1909: Charles J. P. Cave.—Report on Balloon Experiments at Blackpool: Capt. C. H. Ley.—Registering Balloon Ascents at Liverpool, June 21st to 23rd, 1910: W. Marriott.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Specimens of British Mycetozoa: A. E. Hilton.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, NOVEMBER 17.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Effect of Gravity upon the Movements and Aggregation of *Euglena viridis* Ehrb. and other Micro-organisms: Harold Wager, F.R.S.—The Influence of Bacterial Endotoxins on Phagocytosis (including a new method for the Differentiation of Bacteria). (Second Report): L. S. Dudgeon, P. N. Panton, and H. A. F. Nilson.—On the State of Aggregation of Matter. Part I. On the Action of Salts in Heterogeneous Systems, and on the Nature of the Globulins. Part II. On the Action of Formaldehyde on Witte's Peptone Part III. On the Solubility of Phenol and certain Crystalline Substances in Salt Solutions: Dr. S. B. Schryver.—The Proteolytic Enzyme of Drosera: Miss Jean White.—A Method for Isolating and Growing the Leprosy Bacillus of Man: F. W. Twort.—The Oxidation of Phenol by certain Bacteria in Pure Culture: G. J. Fowler, E Ardern, and W. T. Lockett.

LINNEAN SOCIETY, at 8.—(1) Theoretical Origin of *Plantago maritima* and *P. alpina*, from *P. coronopus*; (2) Supplementary Observations on the Theory of Monocotyledons being derived from Aquatic Dicotyledons: Rev. George Henslow.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Research Meeting. Origin of the Present Geography of Northern Nigeria: Dr. J. D. Falconer.

FRIDAY, NOVEMBER 18.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Development of Road Locomotion in Recent Years: L. A. Legros.

CONTENTS.

THURSDAY, NOVEMBER 17, 1910.

THE CELLULOSE AGE.

Die Chemie der Cellulose unter besonderer Berücksichtigung der Textil- und Zellstoffindustrien. By Prof. Carl G. Schwalbe. Erste Hälfte. Pp. 272. (Berlin: Gebrüder Borntraeger, 1910.) Price 9 mk. 60 pfg.

THIS work is created by an opportunity, and in producing it the author has obeyed what in another walk of life would be a "call"—Germany not having produced a text-book or systematic work on this subject, the hiatus is a sufficient *raison d'être* for this publication. The author's qualifications as a worker in the field of cellulose promise a worthy fulfilment of his task, and we may say at once, the volume before us—the moiety of the work to be completed in and by a second volume, to appear at the end of this year—is a weighty contribution to the literature of this section of organic chemistry.

The general title presages a systematic treatment of the subject-matter; but the plan and method laid down are not critically selective, and the result is rather a classified account of original investigations, under sectional titles, such as "Cellulose and Alkalis," "Cellulose and Acids," "Cellulose and Salts," and "Colouring Matters" and "Oxidants," &c. The second part of the volume under the main title, "Derivatives of Cellulose," deals successively with "hydratcelluloses," "hydrocelluloses," "oxycelluloses," "hydracelluloses," "acid celluloses," &c.

The result is in effect a compilation, an edited bibliography. In recording this general impression we do not wish to detract from the value of the book; we merely note for the benefit of our fellow-students that there is a certain nonconformity of its matter with the title, and the promise of a pioneer work, which it contains, is still unfulfilled. The sub-title, "with special reference to the textile and wood pulp (zellstoff) industries," also fails to impress itself upon the plan or method of treatment, and therefore a dominating technical aim or *Leitmotiv* is no more in evidence than the critical scientific. The second volume yet to appear may modify these impressions; but we do not anticipate that the work will take rank otherwise than as an exhaustive bibliographical record. If we infer that this may be the author's intention, it is because we have no special or self-revealing preface (*Vorwort*), only a general introduction (*Einleitung*), and the reader is left to form his conclusions.

Following the short introduction in which technical rather than scientific generalities are prominent, we are confronted at once with the full complexity of cellulose in the title of section 1, "Die Baumwollecellulose Luft und Licht." To open with the problems connoted by this title is indeed to build from the top, upon foundations laid in the air. A merely *a priori* analysis challenges all we know *plus* a well-defined estimate of what we do not know of cellulose as a chemical individual, in being. The next section, "Baumwollecellulose und Elektrizität," continues to occupy the reader with problems of much complexity and obviously of the most general import. The phenomena and reactions involved are those of the cellulose aggregate, of which nothing can be affirmed. Section 4, "Die Baumwollecellulose bei Wärmezufuhr," continues the study of the aggregate in relation to energy. The series of decompositions presented by destructive distillation are infinitely varied, and pyrogenetic products of resolution are generally the least simply related to the parent substances or molecules; the author does not attempt this genealogical investigation.

We notice in passing that no mention is made either of the specific heat or heat capacity of cellulose, or of the physical phenomena, such as changes of volume and dimensions, within the range of temperature—*i.e.* up to 150°—which conditions the persistence of cellulose as a chemical individual. Since cellulose and many derivatives are now produced in the form of solids of regular and controlled dimensions, this important direction of physical investigation is opened up.

The following and main sections are devoted to the changes determined in the cellulose complex by the action of acids, alkalis, and salts and oxidants, and its relations to colouring matters and "mordants," generally to such compounds which enter into what it is now fashionable to call "adsorption" combination. It is particularly in the treatment of the complex phenomena attending hydration, hydrolysis, and condensation, that the author should have adopted a critical method. A "genial" drawing is worth a volume of photography, and if the author had trusted himself as impressionist rather than camera artist he would have used his great opportunity to more adequate purpose. No chemist regards "hydrocellulose," "hydracellulose," "hydratcellulose," "oxycellulose," as terms defining chemical individuals; they connote a more or less definite equilibrium of action and reaction within the cellulose aggregate, which is susceptible of infinitely varied "schemes" of degradation; these are better classified in relation to the determining conditions than in terms of presumed end-products. The alternative method, with the conscientious discharge of the duties of an "all-truistic" bibliographer, leaves the reader without mental pictures which are the pleasurable reward of the diligent student. Students of the natural sciences bewail a tendency to over-population of their book-world as of other "worlds." The literature of cellulose is already of formidable dimensions, and yet its fundamental chemistry can be set forth on the proverbial "half-sheet of notepaper."

The present phase of diffuse expansion in the region of "cellulose" and other typical colloids calls for a more critical attitude of workers and investigators, both in the researches undertaken and the extent of their records.

We may note in conclusion that the volume, in paper covers, weighs 733 grams. It involves therefore a considerable weight of cellulose; and, moreover, the printing and finish of the volume are unusually excellent.

D

DESCRIPTIVE METEOROLOGY.

Descriptive Meteorology. By Prof. Willis L. Moore, Chief of United States Weather Bureau. Pp. xviii+344. (New York and London: D. Appleton and Company, 1910.) Price 12*s.* 6*d.* net.

A TEXT-BOOK by the Chief of the great Weather Bureau of the United States of America will be received with not a little interest, and Prof. Willis Moore, in submitting this treatise, has had before him the definite aim of providing the young men entering the service of the bureau with "a comprehensive introduction to modern meteorology." We think that the author has in most ways successfully realised his aim, though the great prominence given to American methods and the researches of American official meteorologists make the work to some extent unsuitable for adoption as a text-book for students in other countries. The author warmly expresses his obligation for valuable help received from various colleagues—Abbe, Bigelow, Kimball, Henry, Cox, and Humphreys—and the extent of this indebtedness will be appreciated by those familiar with the writings of these specialists in the "Monthly Weather Review" and in various official bulletins of the bureau. We should have been glad, however, if attention had been directed somewhat more fully to the splendid work of A. L. Rotch, for a book such as this should be a source of inspiration to the student, and nothing in American meteorology is more inspiring than a consideration of the history of the Blue Hill Observatory.

To indicate briefly the scope of the work, we may say that the science of meteorology is given the widest possible reference, and that great attention is devoted to the dynamics of the subject. The opening chapters deal very fully with such general questions as the composition of the earth's atmosphere, the physical condition of the sun and its relation to the earth's atmosphere, and radiation waves in their different forms. Passing to a consideration of the vertical and horizontal distribution of temperature, a special chapter is devoted to an interesting study of the so-called "isothermal layer," where perhaps de Bort's term, "stratosphere," might have been adopted. A discussion of atmospheric pressure and circulation follows—where Buys Ballot's name is not mentioned—and Bigelow's work is summarised in considerable detail. Chapters on anemometry and the winds of the globe, on clouds, and on precipitation in its various forms, are good, but the international classification of clouds should have been included. Then follows an admirable discussion of weather forecasting, a chapter on meteorological optics, and a final one on climate—somewhat discursive, but excellent in its treatment of the influence of topographical conditions.

Prof. Moore is a master of the art of condensation and the fortunate possessor of a good sense of proportion, and these qualities have enabled him to cover a wide field in a satisfactory manner. The great organisation the work of which he directs touches the practical interests of the people at many points, and he is at his best in discussing the practical problems of weather forecasting, which are illustrated by an excellent series of weather maps. Again, his brief discussions of such questions of perennial popular interest as the influence of forests on rainfall and the supposed influence of the Gulf Stream on the climate of western Europe are excellent. It was perhaps well practically to exclude mathematical formulæ, but we think that here and there the book might have been strengthened by the inclusion of statistics in tabular form. Thus the vital differences between insular and continental climates would have been most forcibly brought home to the student by actual data for actual places along some given parallel of latitude across, say, the Eurasian continent.

Each chapter concludes with an excellent bibliography, but the attention of American students might have been directed to the research papers issued from the British Meteorological Office during the last few years. And the book properly ends with an index, but a glance at this leaves us puzzled as to what principle was adopted in the inclusion of proper names. Buchan and Rotch are merely mentioned in the book, and their names are not quoted, nor are those of Bigelow and Humphreys, though their work is laid under heavy contribution, whilst those of less well-known authors are given. In a book published in 1910 a different adverb should have been used in a reference (p. 194) to "Sir William Thomson (now Lord Kelvin)."

The publishers have done their work well and the volume is a handsome one. The numerous illustrations and charts are excellent, though the map representing the normal distribution of rainfall over the United States would have been more readily grasped had it been printed in different shades of colour instead of merely with red isohyets running over a white surface.

THEORIES AND PHYSICS OF THE SUN.

(1) *Les Théories Modernes du Soleil.* By J. Bosler, "Encyclopédie Scientifique." Pp. xii+370+xii. (Paris: Octave Doin et Fils, 1910.) Price 5 francs.
(2) *Vorlesungen über die Physik der Sonne.* By Prof. E. Pringsheim. Pp. viii+435. (Leipzig and Berlin: B. G. Teubner, 1910.) Price 16 marks.

IN the first of these two books, dealing with our central luminary, the sun, the author presents his readers with a very well-arranged survey of the more modern views with respect to this important body. The author, who is one of the astronomers at the Meudon Observatory, is in a particularly good position to become acquainted with modern solar researches and opinions, and the solar work in progress at that observatory is second to none.

The book bears evidence of the author's command of his subject, and the method of placing the material before his readers which he has adopted is one that is highly commendable and particularly suitable for the valuable series of volumes which form this "Encyclopédie Scientifique."

Commencing with the general theories of the solar constitution, he makes a brief *résumé* of older views up to 1860, which include those of Herschel, Kirch-

hoff, Zöllner, Secchi, &c. Then at some length the circular refraction and anomalous dispersion theories by Schmidt and Julius respectively are discussed. The temperature of the sun comes next under review, followed by a chapter on the dynamic and thermal equilibrium of the sun. Lastly, the electromagnetic field of the sun and the theories concerning the corona are taken in hand, and the views of Schuster, Bigelow, Deslandres, Ebert, Nordmann, Arrhenius, &c., are contrasted. This chapter also includes an account of Hale's work on the magnetic field in sun-spots, and recent researches carried out at Meudon on the high level strata of the solar atmosphere.

The text is well illustrated with numerous reproductions from recent solar researches, and the volume contains good bibliographical author and subject indices.

(2) Prof. Pringsheim's book is the outcome of a set of lectures which extended over a series of years at the Berlin University. These lectures were not restricted to astronomical students only, so that the subject was dealt with in a little more popular manner than otherwise would probably have been the case.

The twelve lectures which form the subject of this volume comprise a comprehensive survey of the past and present views relative to the physics of the sun, and the author has managed to include a great deal of material in these lectures. The information has been brought well up to date, and the monochromatic work accomplished by the aid of the spectroheliograph in the hands of Deslandres and Hale has been thoroughly dealt with, and forms a valuable chapter. The volume is well illustrated, contains a great number of references, and is accompanied by useful subject and name indices. It will be found a serviceable book for students and a good readable volume for those who wish to become acquainted with the progress in our knowledge of the physics of the sun.

SOME ASPECTS OF PHYSICAL CHEMISTRY.

(1) *The Elements. Speculations as to their Nature and Origin.* By Sir William A. Tilden, F.R.S. Pp. xi+139. (London and New York: Harper and Brothers, 1910.) Price 2*s.* 6*d.* net.

(2) *The Relations between Chemical Constitution and Some Physical Properties.* (*Text-Books of Physical Science.* Edited by Sir William Ramsay.) By Prof. Samuel Smiles. Pp. xiv+583. (London: Longmans, Green and Co., 1910.) Price 14*s.*

(3) *Physical Chemistry. Its Bearing on Biology and Medicine.* By Prof. James C. Philip. Pp. vii+312. (London: Edward Arnold, 1910.) Price 7*s.* 6*d.* net.

THE discovery of radio-activity has, by the introduction of a new idea, reawakened interest in many outstanding problems of physical science. Prominent among these is the fascinating question of the nature and origin of the elements. Chemists with the periodic table of Mendeléeff before them, in spite of the warnings of its author, have been unable to resist the idea that some close genetic relation exists between the different elements of the nine groups of which the table consists, certainly along the vertical lines and probably also along the horizontal series. As to the nature of this relationship, nothing very definite was known or even imagined beyond the fact that it was accompanied by increase in atomic mass, and the probability that it was the result of condensation of some primal matter or protyle, under the influence of changing conditions, of which temperature was possibly one of the chief factors.

(1) The effect of recent work on the views entertained by chemists on this question forms the subject-matter of the latter portion of Sir William Tilden's book, the former half being devoted to a brief and clear exposition of the ideas which led to the formulation of the periodic law. The interesting account given of the various theories of the evolution and constitution of the elements which have recently been proposed culminates in a tentative and most suggestive genealogical table of the elements, which cannot fail to arrest the attention of all chemists. The author favours the idea that the elements of the seven chief vertical groups (with exception of the families headed by copper, chromium, and manganese) are directly "descended" from the seven elements from sodium to chlorine, the members of the odd and even series forming separate families with a common ancestor. The remaining elements (Group 8 and the exceptions just mentioned) are more or less directly descended from iron, which itself is placed in genetic relation with aluminium. The elements sodium to chlorine are direct descendants of the corresponding elements of lower atomic weight, lithium to fluorine, and these are themselves formed by the condensation of varying proportions of the two primal constituents of all matter, positive and negative protyle, as to the nature of which nothing is known. It is, moreover, by the addition of further amounts of these two primal substances that one element is derived from another of lower atomic weight.

Hydrogen is a progenitor of lithium, and a new unknown element, of atomic weight 3, is postulated as a precursor of fluorine. The elements of the zero group (the helium gases) are supposed to be by-products of the disintegration of elements of high atomic weight, possibly long extinct. In this connection it may be noted that the radium emanation is stated to be wholly converted into helium, a conception at variance with the generally received idea.

Such a scheme, in the nature of things, teems with doubtful points, and the author is to be congratulated on his courage in exposing his ideas to the shafts of criticism which are sure to be winged against them. His table, however, undoubtedly expresses much that has been vaguely in the minds of many chemists, and removes some of the chief difficulties inherent in the classification of the elements in the strict order of their atomic weights. Where it appears to be deficient is in the expression of the relations between the members of the horizontal series. It must also be remembered that the only positive evidence of genetic relationship at present

available, which is afforded by the disintegration of the radio-active elements, seems to indicate that devolution occurs primarily along the horizontal series, and that the highest known member of the helium group—the newly-christened niton—takes its place in the chain of descent along with the other elements, and cannot be regarded simply as a by-product.

Enough has been said, however, to indicate the great interest attached to this short work, and the service rendered by the author in presenting in a collected form the ideas of chemists, enriched by his own suggestions, on this fundamental problem of the science.

(2) Dr. Smiles treats of a subject much more amenable to experiment than the disintegration of the elements, and the perusal of his bulky volume shows how difficult it is to arrive at any but empirical relations between physical properties and chemical constitution, even when the effect of every minute change in constitution can be examined experimentally. The work deals with the chief physical properties of the elements and their compounds (with certain exceptions which have already been considered in other volumes of the series), and provides an extremely useful compendium of the work which has been done in this connection. The author has, however, not allowed his subject, great as is the mass of detail comprised in it, to overwhelm him, but has throughout paid special attention to the applications which have been made of the knowledge acquired to the solution of problems of constitution, and to the effect of progress in this branch of the subject on the general trend of chemical theory. The interest is further increased by a preliminary clear account of the nature of each physical property in turn, and a historical sketch of the progress of knowledge with regard to it. The author's final conclusion that further advance will depend essentially on a more complete solution of the problem of valency will probably commend itself to most chemists, and there seems little doubt that, as foreshadowed in many parts of this book, the study of physical properties will be an important factor in the attainment of this result.

In his exposition of the general principles of physical chemistry (3), Dr. Philip has aimed at giving an account of the subject which will be of special value to workers in the borderland regions of biology and chemistry, and has therefore adapted his book both in scope and treatment to attain this end. Without any sacrifice of scientific accuracy, he has given a sound and readable account of the subjects of chief interest to biologists, and has illustrated them wherever possible by reference to problems of a biological nature. In addition to the ordinary fare of works on elementary physical chemistry, special attention is paid to osmosis, permeability and impermeability of membranes, the properties of colloids and adsorption. On the whole, the author has succeeded admirably in his purpose, and has provided a valuable and interesting introduction to the subject, not overburdened with detail and almost free from those mathematical subtleties which are too frequently the despair of biologists.

ARTHUR HARDEN.

CHEMISTRY FOR FIRST-YEAR STUDENTS.

(1) *A College Text-book of Chemistry.* By Prof. Ira Remsen. Second edition, revised. Pp. xxiii+702. (London: Macmillan and Co., Ltd., 1908.) Price 10s. net.

(2) *Outlines of Chemistry. A Text-book for College Students.* By Prof. Louis Kahlenberg. Pp. xix+548. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1909.) Price 11s. net.

(1) THE first edition of Prof. Remsen's "College Chemistry" was somewhat unfavourably reviewed in these columns [NATURE, vol. lxv., p. 314 (1902)], and, unfortunately, most of the faults then pointed out recur in the present edition. Notable exceptions are, however, the treatment of the ionic hypothesis and of the determination of molecular weights from measurements of osmotic pressure. The least satisfactory portions of the work are those dealing with physical and electro-chemistry. Even on the purely chemical side there are some passages which might be amended. Thus it is not generally true, as stated on p. 144, that metals can be distinguished from non-metals according to whether they do or do not liberate hydrogen from hydrochloric acid to form chlorides. (A better criterion is, however, given on p. 169.) On pp. 185–6 volumetric analyses are calculated on the objectionable system based on a consideration of the weights of the reacting substances in the respective measured volumes, instead of by the straightforward "equivalent" method.

These faults are the more to be regretted since the book is in many ways admirably suited for the purpose for which it is intended. Thus Chapter V., dealing with the atomic theory and the determination of atomic and molecular weights, is, for the most part, a model of clearness. Attempts have been made to bring the work up to date by the insertion of short references to the phase rule, catalysis, the electron theory, radioactivity, &c. Within the scope allowed, the systematic descriptive portion is excellent. The experimental exercises given at the end of each chapter are well chosen; but, unfortunately, few first-year students in this country would have the time or the laboratory facilities for carrying them out.

(2) Prof. Kahlenberg's book is, like the preceding, intended for first-year students, and of necessity covers much the same ground; but there the resemblance ends. The general plan, as set forth in the preface, is to lead up to general theories through the fundamental facts and laws instead of first laying down general propositions and then illustrating these by facts. Accordingly, no mention of the atomic and molecular theories or of chemical nomenclature and symbols is made until the sixth chapter is reached.

Physical chemistry does not occupy a prominent place in the book; nevertheless, seeing that Prof. Kahlenberg is practically the only opponent of the generally accepted ionic hypothesis to be taken seriously, we turn with interest to the pages dealing with this part of the subject. On p. 429 we find the remark: "The main difference between the Clausius and Arrhenius theories is that the latter assumes the

presence of a very much larger percentage of dissociation"; and on p. 432, "The reader will have no difficulty in comprehending books that still use the nomenclature of the theory of electrolytic dissociation by remembering that the term *ion* as used in expressing chemical change means the same as atom or radical" (*sic*).

The periodic law is discussed in Chapter XX., but in the arrangement of the descriptive matter it is entirely ignored. This is a great drawback, as inorganic chemistry without the periodic law and the ionic hypothesis becomes a mere jumble of disconnected facts, difficult to remember, and still more difficult to assimilate. Otherwise the book contains as much pure chemistry as a student of medicine or engineering, who can devote only one year to the subject, requires. There are also short accounts of the chief processes in applied chemistry.

OUR BOOK SHELF.

Super-organic Evolution. Nature and the Social Problem. By Dr. E. Lluria. With a preface by Dr. D. Santiago Raman y Cajal. Translated by Rachel Challice and D. H. Lambert. Pp. xix+233. (London: Williams and Norgate, 1910.) Price 7s. 6d. net.

"MAN is a product of universal mechanics."

"*The solution of the social problem is contained in the law of evolution.*"

"There exists an irrefragable law which has made man out of a conglomeration of matter, and this same law, sooner or later, will have to be followed, in order that man himself may attain the state of happiness that is his legitimate aspiration."

These aphorisms lie at the root of Dr. Lluria's philosophy. The researches of Don Santiago Raman y Cajal into the phylogeny and ontology of the nervous system have greatly impressed him, and a third of the volume is occupied with an account of them. He assumes that the nervous system of man will continue to increase in complexity. "The brain of man still continues its psychic evolution." While agreeing that this is "a conclusion of paramount value," we fail to trace the logical steps by which it is reached, and the same may be said of the further inference, "In society, super-organic organism, the rapidity of change will be greater than in any other."

With the best will in the world, it is not easy always to follow the author, as, *e.g.*, when he tells us that "Society lives in a profound error as to property. It has chosen the paltry medium of money instead of the grand inheritance of Nature, which belongs to it by right, confirmed by the theory of evolution." But it is not only society that is to blame. "The responsibility falls particularly on many men of science who have not understood the theory of evolution, giving it, for example, such a false and iniquitous interpretation as *the struggle for existence*—a dreadful distortion of the natural course of ideas."

It is unfortunate that the translator is evidently unfamiliar with the technical terminology which is inseparable from a treatise of this description. There is no index.

The Romance of Modern Astronomy, describing in Simple but Exact Language the Wonders of the Heavens. By Hector Macpherson, Jun. Pp. 333. (London: Seeley and Co., Limited, 1911.) Price 5s.

COMMENCING with a chapter on our place in the universe, the author proceeds in the established sequence with chapters on the earth's motions, the sun, Mercury, Venus, &c., completing the discussion of the solar system with comets and shooting-stars. At more remote distances the suns of space, stellar motions and systems, and nebulæ are the subjects claiming the writer's pen. Some forty pages are devoted to tides, the spectrum and other incidental subjects, while five chapters deal with popular aspects of astronomical history.

The treatment, though generally clear and accurate, seldom rises above the commonplace. A feature which cannot be commended is the persistent introduction of somewhat lengthy quotations from other writers on astronomy. This method of providing "purple patches" discounts the individuality of the writer, whether it be due to modesty or otherwise.

Though steering clear of error in his elementary exposition, the author is not guiltless of loose statements, such as that silver-on-glass reflectors "have a light-gathering power far exceeding the telescopes whose mirrors are constructed of speculum metal."

Many of the illustrations are new, and, on the whole, well done, the artist being successful in finding picturesque settings for some of the more common astronomical happenings. The frontispiece, however, is very misleading; here an enlarged drawing of the head of Halley's comet fills the picture above a portion of landscape, put in doubtless for effect, the whole giving the impression that the coma stretched from zenith to horizon.

The Practice of Soft Cheesemaking. A Guide to the Manufacture of Soft Cheese and Preparation of Cheese for Market. By C. W. Walker-Tisdale and T. R. Robinson. Second edition, revised. Pp. 94. (London: Office of the *Dairy World*, 1910.) Price 1s. net.

A SECOND edition of this little book having been called for, the authors have taken advantage of the opportunity for introducing a certain amount of new matter. With true commercial instinct, they have put in a section describing fully the preparation of Bulgarian sour milk and sour cheese, but their chief object is to give a number of recipes for making soft cheese—often known as cream cheese—likely to sell well and at a good profit.

Soft cheese is a much simpler matter for the producer than ordinary cheese. No great capital or strength are required; the uniformity desirable for butter-making is not needed, so that comparatively small volumes of milk suffice, and the best demand exists precisely at the time when milk is in greatest abundance, *i.e.* in spring and summer. It is therefore essentially a product that the small holder can go in for, and the recognition of this fact by the authors adds greatly to the value of the book. The process of manufacture is simple, and consists merely in adding rennet to milk or to a mixture of milk and cream, then separating the coagulum, and allowing it to drain. There are, however, numerous details that require attention, but these are fully set out.

The book will be found very useful for dairy students and small holders, as well as for the growing class of dwellers in the country who keep a cow for their own use.

Twelfth Report of the Woburn Experimental Fruit Farm. By the Duke of Bedford, K.G., F.R.S., and S. U. Pickering, F.R.S. Pp. iv+51. (London: Amalgamated Press, Ltd., 1910.) Price 1s. 7½d. (post free).

IN this, the twelfth report issued from the Woburn fruit farm, the authors deal with the silver-leaf disease of plums and other fruit-trees in the thorough manner that characterises all their work. This disease is caused by the fungus *Stereum purpureum*, but the

relationship is less obvious than usual, because the fungus only fructifies on the tree that it has killed, and the mycelial threads are only discoverable with difficulty on the living wood. The proof lies in the fact, well brought out in this report, that inoculation of a healthy tree with a piece of the fungus nearly always causes the disease.

As its name implies, the disease is characterised by the silvery look taken on by the leaves, due, apparently, to a disconnection of the cells. Changes in nutrition processes are, no doubt, the immediate cause, but it is suggested that the final cause is a poison formed during the growth of the fungal threads, which then spreads into the tree. This hypothesis explains, among other things, why the fungus is never found on the diseased leaves. The disease is usually fatal. All kinds of fruit are not equally susceptible; plums come first, followed by apples, laburnums, Portugal laurels, and pears as the least susceptible. If a tree recovers, it may still be badly attacked again; there was nothing to show that previous infection tends to immunise trees against subsequent attacks.

In New Zealand, where this disease is also troublesome, the application of ferrous sulphate is recommended as a remedy, but the authors cannot find that it is of any value. Indeed, no method of treatment seemed trustworthy, and all that the grower can do as yet is to burn affected trees and so prevent the disease from spreading.

Elementary Treatise on Physics, Experimental and Applied, for the Use of Colleges and Schools. Translated from Ganot's "Éléments de Physique." By Dr. E. Atkinson. Eighteenth edition, edited by Prof. A. W. Reinold, F.R.S. Pp. xiv+1225. (London: Longmans, Green and Co., 1910.) Price 15*s*.

ALL teachers and most students of physics know Ganot's "Physics," and will be interested in the appearance of another new edition. On examining the new volume they will find changes in the arrangement of subjects and chapters. In the section dealing with heat, the subjects of solution, equilibrium, and liquefaction have been put into separate chapters. Radiation is now dealt with under light. In numerous parts of the book extensive additions have been made, and much new matter on modern subjects of physics of great importance has been added. But to prevent an undue increase of size, sections dealing with matters of no interest to students of to-day have been omitted. In its new form the treatise is likely to continue its popularity. When another edition is necessary the editor should substitute a modern form of rain-gauge for that on p. 1146, and revise the section on the Gulf Stream on p. 1172, where several time-honoured fallacies are repeated.

Dunkelfeldbeleuchtung und Ultramikroskopie in der Biologie und in der Medizin. By N. Gaidukov. Pp. vi+83+Tafel v. (Jena: Gustav Fischer, 1910.) Price 8 marks.

THIS booklet gives a brief but fairly complete summary of the researches which have been pursued by means of dark ground illumination and the ultramicroscope in the domain of biology and medicine. Thus the structure of colloids and of "sols" and "gels" and the minute structure of various animal and vegetable cells as revealed by these methods are epitomised. But the methods themselves receive but the scantiest notice, the theory of the subject and the apparatus being dismissed in the space of a couple of pages. Those who desire to work at the subject will therefore have to seek instruction elsewhere. In some cases we do not think justice is done to ordinary methods of illumination; in Fig. 5, for example, a comma bacillus is depicted as being practically structureless when viewed by transmitted light, whereas with care a certain amount of structure can always be made out. Dark ground illumination no doubt does much to elucidate the finer structure of minute unicellular organisms; how far the ultramicroscope will help remains to be proved.

The work concludes with a very useful bibliography, and is illustrated with numerous figures in the text and five plates, two of which are coloured.

R. T. H.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Limiting Line of Sedimentation in Wave-stirred Areas.

IF you can spare the space I think I can put your reviewer (October 6, p. 433) in the way of obtaining the information he seeks as to the "limiting line of sedimentation" in "wave-stirred areas." The presence of tidal and other currents is assumed.

In a paper to the Royal Society in 1882 I chanced to hit upon this limit, experimentally and incidentally, in the following observation:—

"Dried peas placed on a glass plate in a slight depression on a sandy bottom in 6 inches of water were rolled off by waves about 12 inches long and about 1 inch high. . . .

"Shorter waves $1\frac{1}{2}$ inches high had much less effect on them. A little sand that had collected on the glass was beautifully rippled with $\frac{1}{8}$-inch ripples" (Proc. Roy. Soc., 1882, p. 16).

According to this chance experiment the limit was rather more than half the wave-length.

In 1884 I submitted to the late Sir G. G. Stokes, F.R.S., the case of a soda-water bottle, trawled at about 40 fathoms in the English Channel, which exhibited evidence that it had been subjected to long periods of quiescence, with intermittent disturbance. Sir George Stokes replied in the very important letter published in my paper on the Skerries Shoal (Trans. Devon. Association, 1887, p. 498). For publication in the same paper I had asked Lord Rayleigh to give me some simple formula for ascertaining the practical limit of wave-action. His reply was:—

"For each step downward of $\lambda/8$ divide by 2·2." I may mention that λ represents the wave-length.

Now according to this formula the disturbance at a depth of half (or four-eighths) of the wave-length is about one-twenty-third of that at the surface, whereas at the depth of five-eighths it is about one-fiftieth. I believe that one-fiftieth is negligible, whereas one-twenty-third is not always so.

Thus the limit of disturbance lies between half and five-eighths of the wave-length.

This exactly agrees with my accidental tank experiment.

For further confirmation I may refer your reviewer to Stevenson's interesting discussion on the "Level assumed by Mud a Measure of Exposure" (Stevenson on Harbours, second edition, p. 16).

I will not trouble your reviewer with my own papers except to mention one in the Linnean Society's Journal, Zoology, vol. xviii., p. 263, "On the Influence of Wave-currents on the Fauna inhabiting Shallow Seas."

At the recent inquiry on coast erosion Mr. R. H. Worth cited a delightful zoological proof of a local limit of disturbance. Speaking of *Alcyonium digitatum* and several other hydroids, Mr. Worth stated that:—

"Somewhere below 35 fathoms they will attach themselves to light bodies; above 25 fathoms they will never

attach themselves to anything but heavy bodies" (Royal Commission on Coast Erosion, Ans. 4059).

A steady current has often no disturbing effect on the sea bottom, as the upper strata slide over the lower ones, but the slightest wave-action on the bottom, with its alternating currents, is most effective; and, as Sir George Stokes pointed out (I believe for the first time), the combined action of wave and tidal current may be very energetic, as in the case he cites, in which the combination of a steady tidal current of two miles an hour, combined with a reciprocating flow of one mile, would result "in a flow rapidly changing between one mile and three miles." I doubt whether this important fact had ever occurred to anyone else; and, up to the present time, no one has taken any notice of it, so far as I am aware.

Torquay. A. R. Hunt.

Two Notes from India.

I am writing to report a rather curious freak lily which I have lately seen out here. It was a garden variety, and it possessed a perianth of eight segments, which, however, is not unusual, but it also possessed eight stamens, the anthers of which were joined together in pairs, the remainders of these organs being separate. The union began about two-thirds of the way down from their apices, and from then up was complete. If any of your readers can suggest a cause I shall be glad to know it; I have never seen such a condition before. I may say that the rest of the organs were normal (there was only one flower on the plant), and both flower and plant were very healthy.

The second note which I might record as well, I think, though I know my statements about it will perhaps make some people doubt my veracity, is that while on duty one day, in the evening, about twenty miles away from Sangor, Central Provinces, in January a year ago, I was driving back through the jungle to Sangor about 7.30 p.m. when I distinctly saw what I consider to be an aurora borealis. The sun had set, and there was no moon out at the time. Suddenly faint streaks, and later distinct and many bright streaks, of light appeared across the sky, and I got out of the tonga and watched it about a quarter of an hour. There was continual vibration and movement of the light as a whole and of individual parts. The light was a plain white one, and very like a zig-zagged comb. No lights of any kind were near, nor could I see the fires or lights of any native villages except faintly in the distance, and these were quite distinct and easily distinguished from the sky phenomena. I pointed it out to my tonga wallah, who shook his head and said he did not know what it was. The stars were out, but that it was not a planetary light I am certain. I imagine the occurrence of this phenomena must be most uncommon in tropical countries, and I noted it in my diary.

J. H. Barbour.

Jubbulpore, Central Provinces, India, October 20.

Instruction in Methods of Research.

In Nature of November 3 appeared an address by Sir W. A. Tilden on modern scientific research.

The technical chemist may hardly agree with his conclusions that the art of scientific discovery cannot be communicated from one person to the other when the matter is considered in its wider aspect, and although it may be true that the great discoveries of the future will be made by the "inspired amateur," yet there is plenty of evidence that in Germany, at any rate, the general increase of knowledge and progress is to a great extent made up in detail work, without which it may also be stated that the great discoveries would never be made. Progress in this detail work to a great extent seems to be influenced, if not controlled, by training in research.

It is interesting to note that some authorities seem to have the impression that in this country the proportion of research men to chemists is higher than abroad.

In the columns of Nature and elsewhere I have previously advocated the teaching of the principles of research in class in all our chief colleges, and I believe that the student when entering them looks for some such training and expects it. This training would be of great value to the majority of chemists, who will naturally find their future work in industry. Its influence must be felt in the conduct of their future work.

The greater part of the time of the industrial chemist is taken up with dealing with unseen difficulties and overcoming them. This may not be research in its proper sense, but these difficulties can only be overcome in one way, and this when examined in detail will be found to be very similar, if not identical, with that necessary for the conduct of research. In fact, such work might be defined as the application of such principles of research to industry. It is not the application of ordinary academic chemical knowledge. That is certain.

So that with such a training, I would venture to point out, the man who has not that "combination of mental powers which is called insight" will derive great benefit, for it seems difficult to think that the student who has passed the entrance examination and gone through the college course can be entirely devoid of some such quality, even if he has not it to a superlative degree. The latter men must be trained, for has not Newton said that "zeal without knowledge is like expedition to a man in the dark"?

Some two years ago I put the question Sir William Tilden mentions of the establishment of central research stations for the chief industries before a textile society in the north.

It was then suggested that there were many difficulties in the way of a technical nature. One of the advantages of such a scheme would consist of the training which might be given to the younger men who are entering industrial work, and it may be that this could, to a great extent, take the place of the practical training in the colleges themselves, which Sir William Tilden, perhaps rightly, depreciates when it is carried too far.

W. P. Dreaper.

Royal Societies Club, St. James's Street, S.W., November 5.

The Armour of Stegosaurus.

Pardon me for saying that there is not the slightest reason to believe that the restoration of Stegosaurus with a double row of plates is incorrect, in spite of the statement of the reviewer in Nature for October 13. Not a single plate of this animal has been found with a symmetrical base, the base always being at an angle to the vertical axis of the plate; this implies that the plates were not placed on the median line, but to one side of it. Furthermore, in the only specimen in which anything like a complete series of plates has been preserved the linear extent of these plates is, roughly speaking, 40 feet, and it is a physical impossibility to arrange them in one series on 20 feet of back. These plates lie in position overlapping one another.

The only point at issue between Dr. Lull, who has studied the Stegosaurs most carefully, and myself is in regard to the arrangement of the plates. Dr. Lull believes that they were arranged in pairs. My own view is that, reasoning by analogy, they *should* have been thus arranged, but the facts in the case point to their having been placed alternately on opposite sides of the median line. No pair of plates has ever been found, and, making the greatest allowance possible for individual variation, it seems incredible that differences of several inches should exist between the plates from the two sides of the body if they were arranged in symmetrical pairs.

F. A. Lucas.

Museum of the Brooklyn Institute.

The above letter from Mr. F. A. Lucas shows that my apologies are due to the author of "Extinct Monsters and Creatures of Other Days." It is Marsh's restoration of Stegosaurus with a single row of dorsal plates that is incorrect, as was pointed out in a notice of Dr. Lull's restoration in the *American Journal of Science* for March, 1910, in Nature for the present year. In writing the review of Mr. Hutchinson's volume I must have trusted to memory, which played me false. R. L.

THE CARNEGIE INSTITUTION OF WASHINGTON AND ITS WORK.

QUESTIONS of the organisation, the objects, and the activities of the Carnegie Institution of Washington are of widespread interest. The demand, indeed, for popular and technical information concerning this institution is far greater than the available supply. It should be stated, however, that it is not practicable to explain in any brief compass the history of the development of so novel an establishment. There has been scant time thus far for those engaged in this development to step aside and write anything but an abstract of current events. It should be stated also that the complexity of the subject is much greater than might appear to casual observation. The institution has recently issued the eighth of its series of year-books, or annual reports. These year-books contain upwards of two thousand pages of condensed history, and when one considers that they embody what is probably the most complicated miscellany of contemporary literature, it may be seen to be no easy matter, even if one had the time, to gain first-hand knowledge by reading these books; and it may also be seen to be no easy matter even for one participating in their publication to give a comprehensive summary of their contents. Only the barest outline, therefore, of this history can be given in the present article, while some major and many minor considerations of interest doubtless to individuals may be referred to only casually or not at all.

On January 4, 1902, a committee of incorporators held a meeting in Washington, D.C., for the purpose of considering articles of incorporation, looking to the establishment of what was subsequently called the Carnegie Institution. This committee consisted of John S. Billings, Daniel C. Gilman, John Hay, Charles D. Walcott, Edward D. White, and Carroll D. Wright. Articles of incorporation were duly approved on the same date, and a board of trustees was thereupon elected. These included the President of the United States, the President of the Senate, the Speaker of the House of Representatives, the secretary of the Smithsonian Institution, and the President of the National Academy of Sciences as ex-officio members, along with twenty-two other members. On January 29, 1902, the trustees of the proposed institution assembled in the diplomatic room of the Department of State, under the chairmanship of John Hay, and received from Mr. Carnegie his recommendations for the foundation of the proposed institution, his outline of its general aims, and his deed of trust, by which he transferred in perpetuity to the trustees as an endowment fund 2,000,000*l.* worth of United States Steel Corporation bonds. These bonds bear 5 per cent. interest, payable semi-annually, so that the original income of the institution was 100,000*l.* In December, 1907, this endowment was increased by 400,000*l.*, so that the present income is 120,000*l.*

FIG. 1.—The Administration Building of the Carnegie Institution of Washington.

The institution was originally incorporated in accordance with the provisions of the laws of the District of Colombia, under the title Carnegie Institution. Subsequently, however, it was re-incorporated by an Act of the Congress of the United States, approved April 28, 1904, under the title of *Carnegie Institution of Washington*, which is now its corporate designation.[1] By this new Act of Incorporation, the institution was placed under the control of a board of twenty-four trustees, all of whom had been members of the original board referred to above. This

[1] The reader's attention may be called to the facts that the Carnegie Institute, located at Pittsburg, Pennsylvania; the Carnegie Foundation for the Advancement of Teaching, with headquarters in New York City; and the Carnegie Institution of Washington are separate and independent corporations.

board is self-perpetuating, but none of its members may be such by reason of official connection with

Fig. 2.—General View of Station of Department of Experimental Evolution, Cold Spring Harbour.

the United States Government or with other organisations. Thus the institution is now, like any other private corporation, neither subject to any special restrictions by, nor benefited by any special privileges from, the Government.

The trustees meet annually in December to consider the affairs of the institution in general, the progress of work already undertaken, the initiation of new projects, and to make the necessary appropriations for the ensuing year. During the intervals between the meetings of the trustees the affairs of the institution are conducted by an executive committee. This committee consists of seven members chosen by and from the board of trustees and the president of the institution, who is a member *ex-officio*, and acts as chief executive officer.

Amongst the aims of the institution specifically set forth in the founder's deed of trust are the following:—

(1) To promote original research, paying great attention thereto as one of the most important of all departments.

(2) To discover the exceptional man in every department of study whenever and wherever found, inside or outside of schools, and enable him to make the work for which he seems specially designed his life-work.

(3) To increase facilities for higher education.

(4) To increase the efficiency of the universities and other institutions of learning throughout the country, by utilising and adding to their existing facilities and aiding teachers in the various institutions for experimental and other work, in these institutions as far as advisable.

(5) To enable such students as may find Washington the best point for their special studies, to enjoy the advantages of the museums, libraries, laboratories, observatory, meteorological, piscicultural, and forestry school, and kindred institutions of the several departments of the Government.

(6) To ensure the prompt publication and distribution of the results of scientific investigation, a field considered highly important.

No great amount of reflection is needed to reach the conclusion that the fields of work thus clearly mapped out by the founder could not be entered without some difficulties. That the organisation of such an institution would be no easy matter might have been inferred also from the experience of the closely similar establishment, the Smithsonian Institution, seventy years earlier, for it may be recalled that the wisdom of the Congress of the United States debated the question of the proper functions of Smithson's foundation for a full decade before arriving at a definite programme for action. Even amongst those best qualified to judge of the merits of the ways and means available for the inauguration of this new enterprise, a great

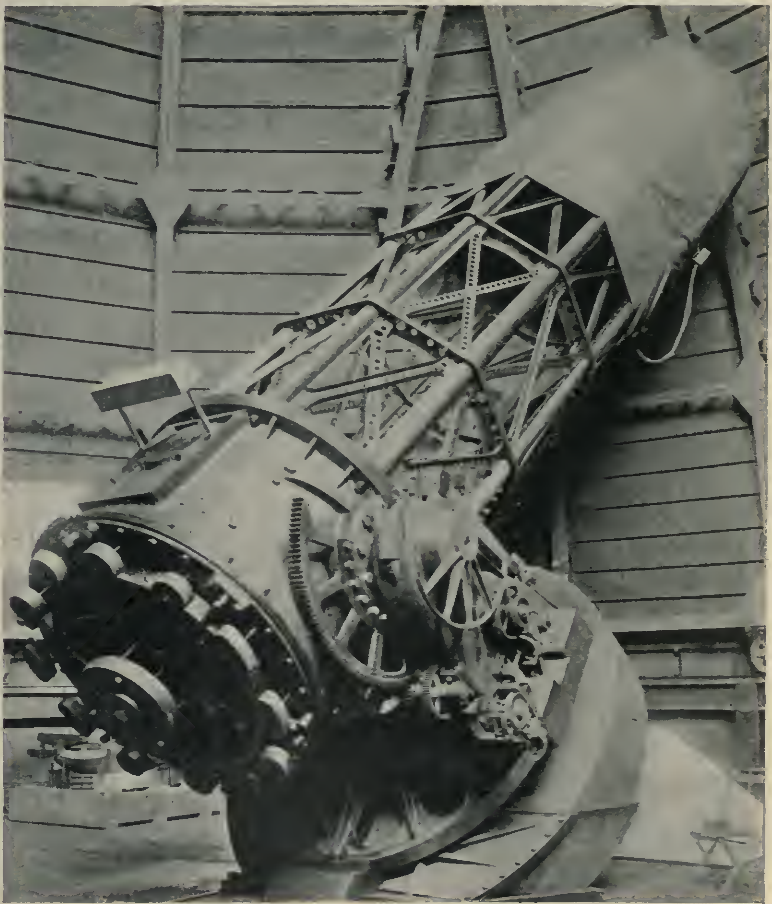


Fig. 3.—Sixty-inch Reflecting Telescope of Solar Observatory.

variety of opinions arose. Indeed, the volume of excellent advice and suggestion received by the

trustees of the institution during the first two years of its existence was overwhelming in abundance. The severity of the situation thus developed, however, was relieved by a humorous aspect found in the fact that it became possible to quote equally expert opinions on all sides of any question relative to the objects of the institution. In order, therefore, to accomplish anything in addition to correspondence it became necessary for the trustees to proceed in a way which has appeared in some degree arbitrary and without due regard to all interests concerned.

The productive activities of the institution have been developed thus far along four principal lines of work. These are, first, large projects organised under and conducted by the institution itself; secondly, minor projects carried on by individuals who are for the most part connected primarily with other institutions; thirdly, the work of research associates and assistants who are temporarily attached to the institution, and who are for the time being engaged chiefly in work of research; and, fourthly, the issue of publications, including especially the results of the investigations accomplished under the first three heads just mentioned, and the publication of investigations of special merit not likely to be cared for under other auspices.

Under the head of large projects, ten departments of work have been established. Two of these departments are devoted to astronomical investigations; three to research in biology; one to economics and sociology; one to research in geophysics; one to historical research; one to investigations in nutrition; and one to research in terrestrial magnetism. To these not inappropriately may be added the divisions in charge of the work of publications and the work of administration, making thus twelve different departments or divisions of work within the institution itself. Each of these principal departments of investigation is in charge of a director who is primarily responsible for the organisation and the conduct of the work entrusted to him. Annual appropriations are made to these departments in conformity with carefully specified budgets drawn up by the directors in cooperation with the president of the institution. Within the limits of his annual appropriation each director is given the largest freedom of action in the prosecution and in the development of the work he has in charge.

Under the head of minor projects many researches in widely separated fields have been undertaken by individual investigators. In round numbers about three hundred of these investigators have been connected with academic institutions. Similarly, limited numbers of eminent research associates have been and still are attached to the institution. In its earlier experience there were appointed also a limited number of research assistants, who were young men and women of promise, but had not yet demonstrated capacity for the accomplishment of fruitful research.

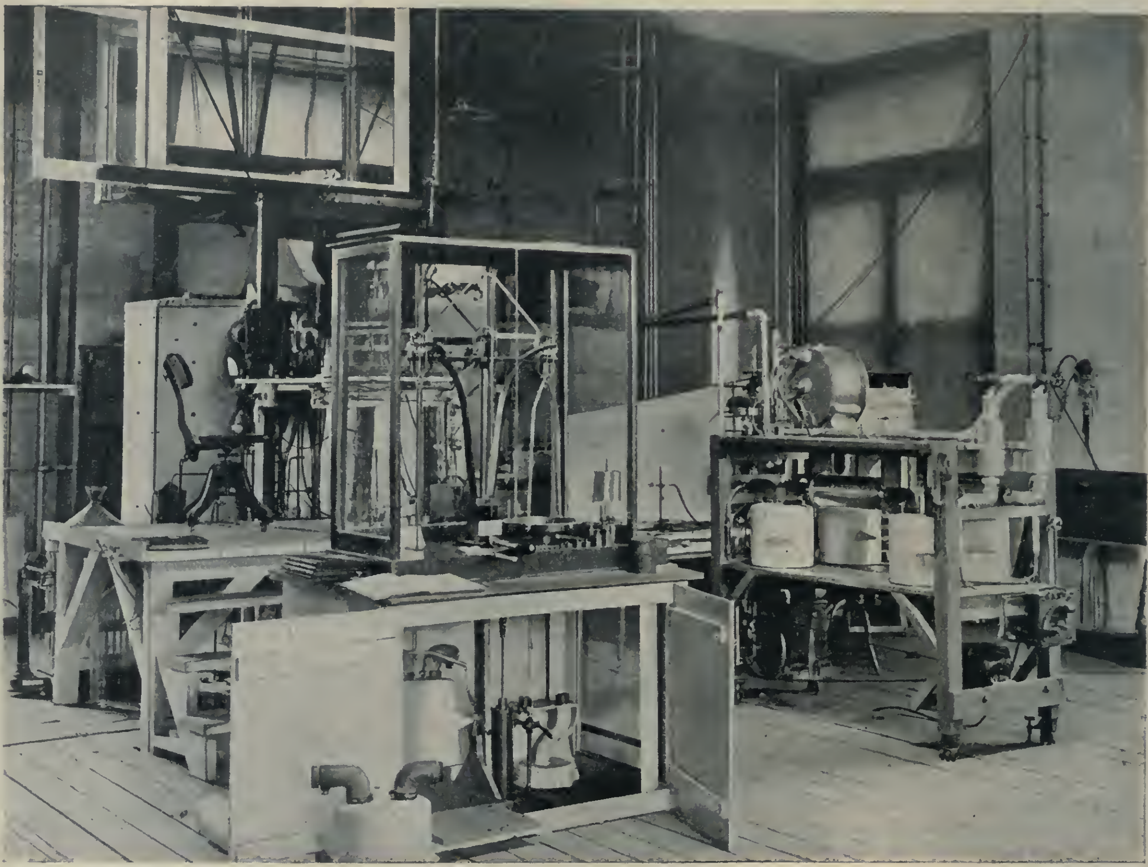


FIG. 4.—Interior View of Nutrition Laboratory.

Next in importance to the work of research is the work of publication carried on by the institution. For this object 10,000*l*. to 15,000*l*. are now allotted annually, and the institution is publishing books at the rate of twenty to forty volumes per year. These publications are distributed gratuitously to a limited list of the greater libraries of the world. They are

also offered for sale at the mere cost of production and transportation to purchasers, which cost is about half that which would be charged if the works were issued through commercial publishing houses. The expense entailed by this work prohibits the issue of large editions for free distribution; in fact, any attempt to meet the public demand for a free receipt of the institution's publications would speedily curtail the prosecution of research.

In addition to the productive work referred to above, there falls to the administrative division especially, in the institution, a large amount of unproductive work. This arises from a very general misapprehension as to the aims, objects, and capacities of the institution. Grossly exaggerated estimates of its income have generated, and tend to maintain, an

FIG. 5.—Non-magnetic Ship *Carnegie*.

extensive aggregate of fruitless correspondence. Deluded enthusiasts and designing charlatans, amateurs, dilettanti, arc-trisectors, circle-squarers, perpetual motion men and women, and all sorts of paradoxers press for endorsement, if not for pecuniary aid. It appears to be a serious defect of existing social conditions that there is no way of preventing those who have nothing to communicate to the world from interfering with those who have.

In closing this brief account of the institution, the effective work it has thus far accomplished may be summarily indicated by the following statement :—

Since its organisation, in 1902, upwards of one thousand individuals have been engaged in investigations under the auspices of the institution, and there are at present nearly five hundred so engaged. Ten independent departments of research, each with its staff of investigators and assistants, have been established. In addition to these larger departments of work, organised and conducted by the institution itself, numerous special researches, carried on by individuals, have been subsidised. Two observatories and five laboratories, for as many different fields of investigation and in widely separated localities, have been constructed and equipped. A building in Washington, D.C., for administrative offices and for storage of records and publications, was completed and dedicated in December, 1909. For ocean magnetic surveys a specially designed non-magnetic ship with auxiliary propulsion was constructed and put in commission during the year 1909. Work in almost every field, from archæology and astronomy to thermodynamics and zoology, has been undertaken, and the geographical range of this work has extended to more than forty different countries. One hundred and fifty-five volumes of researches, with an aggregate of forty thousand pages of printed matter, have been published. Upwards of one thousand shorter papers have been published in the current journals of the world by departmental investigators, by associates, and by assistants. The total amount of funds expended to date in the consummation of this work is, in round numbers, 900,000*l*. R. S. WOODWARD.

THE ROOSEVELTS IN AFRICA.[1]

NO one can read this interesting book by Mr. Roosevelt, sen., without realising how much the record owes to the work of Roosevelt, jun., of Kermit, the boy of nineteen to twenty who, before he had reached his twentieth year, had contributed some of the finest trophies to the expedition, who, though slight of build and boyish of aspect, confronted great dangers with calm resourcefulness, who took admirable photographs, and assisted the work of the expedition as a collector with the greatest zeal and usefulness.

The book under review is not without its defects and incongruities, and the expedition of which it is the record has received heavy censure from a good many people interested in the preservation of the world's fauna. Theodore Roosevelt, its author, has the defects of his qualities. His remarkable disposition and character have somewhat (as in the case of the late Sir Henry Stanley) prejudiced the judgment of a good many critics. In the first place, Mr. Roosevelt has not had sufficient leisure in which to do himself justice as the writer of a book on real natural history. Being a poor man when he left the Presidency, he was obliged, to a great extent, to pay the expenses of his very costly expedition by writing an account of it to be published week by week by the newspapers, a full diary, so to speak, of the day's events. Then, taking advantage of a brief rest at Khartum, he puts this diary together in book form, and has barely time to glance at the proofs before leaving England for the States in June. In addition to this, his publisher has thought it wise (and this reviewer feels bound to say that he thinks it unwise) to add to this work on natural history two speeches delivered by Mr. Roosevelt in Egypt and in London; while the author himself, not content with his wonderfully successful expedition and his own vivid appreciation of the African fauna and African landscapes, has further added, under the form of a dissertation on his "pig-skin" travel-library, a dissertation on the world's best books, ancient and modern.

[1] "African Game Trails." An Account of the African Wanderings of an American Hunter Naturalist. By Theodore Roosevelt. Pp. xvii+534. (London: John Murray, 1910.) Price 18*s*. net.

With the speeches delivered at the Muhammadan University of Cairo and at the Guildhall, London, the reviewer in NATURE has nothing to do, since they treat of politics, but he thinks they are out of place in a natural history book. They should have been published with the next volume of Mr. Roosevelt's public speeches, and with them should have been given the other side of the picture, the things he also observed but did not mention publicly, or, if he did so, were not reported by patriotic British stenographers or editors. As it is, these speeches do not give by any means a full statement of Mr. Roosevelt's views on Egypt. As to the "pig-skin library," it is perhaps a dangerous thing for a person of the world-wide influence of Theodore Roosevelt to set up an *index commendatorius* of books ancient and modern, with the inference that books dealing with the subjects he prefers, but not mentioned by him, are not worth the traveller's attention.

The fact is, that a second edition of this work should be brought out, stripped of these unnecessary appendices and the at first necessary, but after wearisome, records of thanks and obligations to a hundred-and-one personages. We should like to see Mr. Roosevelt's book take its place in the ranks with Bates's "Naturalist on the Amazons," Schillings's "With Flashlight and Rifle," and works of such character. He is a good zoologist and a peculiarly accurate and discriminating observer. Although he has traversed lands visited already by some of the great naturalist-explorers of the world, he has still made discoveries himself, or through others, and records a great many facts not hitherto known about the life-history of beasts and birds in equatorial East Africa. He is careful to note the seasons at which the young of different antelopes and other large game appear. He brings home to us, as no previous traveller has done, the extent to which this wild game is persecuted and infested with ticks, to which, however, they seem to have become so habituated that they dread them much less than the biting-flies, though the ticks are probably quite as much spreaders of disease, and even where they do not introduce disease germs must be extraordinarily weakening as blood-suckers. Many birds are devoting themselves in Africa to little else than the picking off and eating of the ticks and flies that infest the mammals. Where these birds are killed by European sportsmen, a great deal of future trouble is no doubt being prepared for us. For example (though I do not think this is mentioned by Mr. Roosevelt), certain types of heron (egret) are perpetually snapping at tsetse-flies, or other flies, which settle on oxen or game, and, if fully protected, might account for a considerable proportion of these disease-carrying creatures.

Photo.] [*Theodore Roosevelt.*

FIG. 1.—The Reticulated Giraffe. From "African Game Trails."

He has much that is new and interesting to say on the subject of the chita hunting-cat, really a little-known and little-studied carnivore in its wild state, both in Asia and Africa. The ordinary rhinoceros and its funny habits receive full illustration at his hands, and the square-lipped, white rhinoceros is revealed to us in its gentler, less aggressive disposition, as well as its association with the white egrets which, in accompanying it for its protection from ticks, whiten its broad back with their guano. (May this fact, equally possible in South Africa with the same kind of white heron, be an explanation of the otherwise absurd description "white rhinoceros"?) He pictures it for us in words, sitting down on its haunches like a dog (and, like its relation, the tapir), and shows us that due importance in description and pictures has not hitherto been given to the hump over its vertebræ at the shoulders. Grevy's zebra and the northern type of *Equus burchelli* (Grant's zebra) are rightly contrasted in appearance, habits, and cry. Some other peculiar features in both zebras, not hitherto recorded by naturalists, are set down here. Besides a good description of the vivid colours of the topi, or bastard hartebeest, he tells us that he has met with forms of the topi which develop a white blaze on the forehead. This is possibly a local sport, but is interesting as being a parallel to the white forehead of a southern type of topi, the blesbok. (This white forehead would seem to arise from exaggeration of the two white, frontal chevron marks which are liable to occur and re-occur in certain types of hartebeest and gnu.)

Mr. Roosevelt gives interesting particulars as regards the lion's method of killing most of the larger antelopes and zebra by springing on the back and biting through the vertebræ of the neck. It is possible that in the case of the stronger zebras or wild asses, the lion flings himself on to the neck itself and drags down the animal's head, biting at the vertebræ not far from the base of the skull. (This is well illustrated by a drawing in Mr. Millais's "Breath from the Veld.") In the case of full-grown buffalo, the lion's attack is generally made in concert, two or three young male lions, or a lion and lioness, working together, but also with the same object of severing the neck vertebræ. Failing this, attempts are made

to hamstring the beast by biting through the tendons of the hind legs, and once it is prone it is eviscerated by claws and teeth.

The alternation of the red-gold Jackson's hartebeest and the black and white Grant's zebra (looking silvery often in a slant of sunlight) is charmingly described; in fact, the book is full of verbal pictures, meet subjects for treatment by a painter. Indeed, on this score Mr. Roosevelt's remarks on the importance of pictures, as well as of photographs, in the effective illustration of wild life, are very sensible.

He describes to us the speed of the chita and its peculiar attitudes and cry, "a bird-like chirrup"; the dancing habits of the male widow-finches (Chera); "the rhinoceros standing in the middle of the African plain, deep in prehistoric thought"; the zebras and their stamping-grounds and their boldness in attacking dogs with teeth and hoofs, and not unreadiness to attack the white man also; the lions with their black and yellow manes (he might also have alluded to the frequency with which East African lionesses are boldly spotted with leopard-like markings, black below, and tawny-brown above); the large cuckoos "which eat mice," and the mice they eat, striped like miniature zebras; the fantastic little elephant-shrews with their probosces; the variety and beauty of the water-birds (not forgetting that creature of lovely tints, the ibis-stork, Pseudotantalus); the white-tailed ichneumons, never sufficiently hitherto commented on in descriptions of East African nature; the bold roan antelopes, with their large mouths and reported habit of biting as well as horning their foes, and squealing savagely when at bay. He gives interesting and precise information regarding the spitting-cobras, describing the venom as it is ejected through the point of the hollow tooth "like white films or threads." He quotes a fellow-traveller to the effect that the giraffe when fighting with other giraffes or other foes, makes little or no use of the short ossicones as a weapon, but strikes with the strong chisel-like teeth of the lower jaw, the blow being delivered with all the force behind it of the immense, heavy neck. The boldness of the hippo in regions where he has not as yet been taught to be afraid of man, is vividly described—the angry combats in the water between rival males, and the departure on shore of the vanquished bull, who, straight away, in a rhinoceros-like rage, attacks on land the native cattle, or even men and women crossing his angry trot. Roosevelt's notes on baboons, hyenas, elephants, white rhinoceroses, water-birds (especially p. 298), Grévy's zebra, white-bellied hedgehogs, the hyraxes, and the forest and mountain rats, are all most interesting, and in nearly every case novel, even to those acquainted with the East African fauna. Excellent in every way are his descriptions of the life of the savage men (invariably kindly towards this expedition), amongst whom and with whom he travelled. His descriptions of the botanical aspects of the country are full of colour and actuality, but are unfortunately marred here and there by the correctly described tree or plant being given the wrong name, either botanically or in the vernacular.

In short, Mr. Roosevelt has written a book which would have been quite as noteworthy and of as lasting

Copyright 1 no.o., [*Kermit Roosevelt.*

FIG. 2.—A Herd of Elephant in an Open Forest of High Timber. From "African Game Trails."

interest if it had been written by an unknown personage. But in its permanent form the relatively trivial press errors and slips of the pen should be corrected and all extraneous matter not connected with natural history, cut out.

The illustrations—drawings as well as photographs—are admirable. Mr. Roosevelt deserves praise for having carefully photographed the small mammals as well as the big.

Special triumphs of the expedition were the shooting by Mr. Theodore Roosevelt of the rare Somali reticulated giraffe, and by Mr. Kermit Roosevelt, of the East African sable antelope. In regard to this achievement, the writer of this review has enjoyed some satisfaction. In describing his own journey to Kilimanjaro in 1884, he stated that he had seen the sable antelope on the way thither. This statement was somewhat rudely derided by a succeeding traveller, who declared that the sable antelope was never found north of the region opposite Zanzibar Island.

H. H. JOHNSTON.

ATMOSPHERIC ELECTRICITY AND RAIN.

THE fact that raindrops often bring down a measurable charge of electricity has been known for twenty years, but numerical measurements have been comparatively few, and data of even moderate trustworthiness are scarce. A recent memoir of the Indian Meteorological Department[1] contains an account of the important work done on this subject in 1908 and 1909 by Dr. G. C. Simpson. This work is partly observational, partly experimental, and partly theoretical. To see its true bearing, reference is necessary to some other aspects of atmospheric electricity.

If we denote by v the electric potential at a height z above the ground, and if dv/dz represents the rate of increase of v with height just above ground level, then treating the conductivity of the air as negligible the earth must have a charge the surface density σ of which is $-(dv/dz)/4\pi$. In ordinary fine weather v increases as we go upwards, and so σ is negative. In practice one usually derives dv/dz from the difference of potential between two points in the same vertical one metre apart. This quantity, termed the *potential gradient*, varies much from day to day, or even hour to hour, and the average value seems to vary considerably at different parts of the earth. If, for example, we suppose it to be 150 volts, then remembering that the centimetre is the unit of length, and that the electrostatic unit equals 300 volts, we deduce $\sigma = -(1/4\pi)(1 \cdot 5/300) = -4 \cdot 0 \times 10^{-4}$ E.U. (or electrostatic units).

Atmospheric air is in reality not a perfect non-conductor. If one gives a body in air on a perfectly insulating support a charge, whether positive or negative, this is gradually lost. Of the numerous observations on the rate of loss of charge those made by Mr. C. T. R. Wilson, with an apparatus which he devised a few years ago, appear least open to criticism. In a paper published in 1908, Wilson[2] gives the result of a considerable number of observations on the loss of negative electricity under fine weather conditions. His mean rate of loss exceeded 8 per cent. of the charge per minute of time. In other words, a charge equal to the earth's charge at any instant was lost every twelve minutes. During these observations the mean value of the potential gradient was 187. This answers to a surface density of $-10^{-4} \times 4 \cdot 97$ E.U., or $-16 \cdot 6 \times 10^{-14}$ coulombs. Taking an 8 per cent. loss per minute, the loss per second—*i.e.* the value of an upwardly directed negative, or downwardly directed positive current—is $(8/60)10^{-2} \times 16 \cdot 6 \times 10^{-14}$ or $2 \cdot 2 \times 10^{-16}$ in amperes. If this represented average conditions, we should have in the course of a year from each sq. cm. of the earth's surface a loss of 7×10^{-9} coulombs, or 21 E.U. of negative electricity. During rain the potential gradient is often negative, but the total duration of negative gradient in the course of a year is not large. We are thus led to the conclusion that whilst 21 E.U. is probably an over-estimate of the charge lost annually per sq. cm. of surface by conduction through the air, it is unlikely to be much in excess of the truth unless the conductivity of the air is exceptionally high at times when the gradient is negative. The question thus arises: How is the earth's charge maintained?

Of the hypotheses advanced of late years, the one that has met with most approval is due to C. T. R. Wilson, who suggested that while districts enjoying fine weather are losing negative charge, other districts are deriving a corresponding amount of negative electricity from falling rain, the circuit being completed below by earth currents, and overhead by horizontal currents at a considerable height. Our knowledge of earth currents at the present moment does not enable us either to affirm or to deny a systematic transfer of electricity between wet and dry areas.

When Wilson's suggestion was made, it was believed that while the electricity brought down by rain was sometimes positive, still negative largely predominated, that being the result arrived at by Elster and Geitel, who were the chief of the early observers. Dr. Simpson's first contribution to the subject was the invention of an ingenious apparatus giving a continuous record of the amount and sign of rainfall electricity. This apparatus has been in operation at Simla during the monsoon or rainy seasons of 1908 and 1909, and the results are of an unexpected character. What the apparatus really does is to collect and record rainfall electricity for two-minute intervals. The data represent the total charges received for each successive interval and the corresponding rainfall. During the two monsoons 172·1 cm. of rain were recorded, with 44·0 E.U. of positive and 13·8 E.U. of negative electricity, or a balance of 30·2 E.U. of *positive*. The two-minute intervals during which a positive charge was measured amounted in all to 4·16 days, as against 1·70 days of negative. During about 37 per cent. of the total duration of rainfall no sensible charge was measured. Snow is rare at Simla, but for such snow as fell there was much the same relative excess of positive electricity as in the case of rain, the chief difference being that snow brought down more electricity than an equal weight of rain. An annual rainfall of 86 cm. is normal enough, and if the corresponding balance, 15 E.U., of electricity had been negative, it would have fitted Wilson's theory well so far; but being positive, it adds to the mystery respecting the source of supply of the fine weather current.

There are some features which raise doubts as to whether Simla phenomena are fairly representative. Rain there seems to be accompanied by much thunder and lightning, and the excess of positive electricity was especially prominent during the very heavy rain accompanying thunderstorms. In 1908, when rain was falling at a less rate than 0·17 inch per hour, the time during which negative electricity was recorded was about 90 per cent. of that during which positive was recorded, and the mean charge per c.c. was 2·2 E.U. for negative, as against 1·7 E.U. for positive, so that in the lightest

[1] Vol. xx., part 8, "On the Electricity of Rain and its Origin in Thunderstorms." By Dr. George C. Simpson, Imperial Meteorologist (also in Trans. and Proc. R.S.).

[2] Roy. Soc. Proc., A, vol. lxxx., p. 537.

rains negative electricity was slightly in excess. The charge per c.c. tended to be larger the lighter the rain, but the fall in two minutes was so small in light rains that it seems by no means improbable that with a more sensitive apparatus there would have been a smaller total excess of positive electricity recorded. Observations covering the complete annual precipitation, whether rain or snow, at a number of stations in different latitudes will be necessary before we can safely draw conclusions respecting the earth as a whole.

It was discovered by Lenard many years ago that in the case of an ordinary waterfall, or when water falls on a solid obstacle, the water drops formed take a positive, the surrounding air a negative charge. Lenard believed, however, that no such separation occurred when drops split up without falling on an obstacle. Simpson found a similar absence of charge when experimenting with Simla tap-water, but on trying distilled water he found that the splitting up of drops by means of a vertical air jet is accompanied by a marked separation of electricity, the water taking the positive charge. The breaking up of drops, each containing about 1/4 c.c. of water, gave the water a charge of about $+23 \times 10^{-3}$ E.U. per c.c. If the drops were already charged, this additional charge was added when they broke, so that the action is cumulative. Raindrops become unstable on attaining a certain size, and tend to break, so that natural conditions approach those of Simpson's experiments. A rational explanation is thus given of a positive charge on rain if it behaves as distilled water. This we should expect it to do, except perhaps in smoky districts, but further experiments on actual rain-water in various localities seem desirable. The presence on some rain of negative electricity is ascribed by Simpson to a transfer of charge from air which has previously surrounded breaking raindrops.

The theoretical problem mainly considered by Simpson is the relation of rain to thunderstorms. He believes that there are normally present in thunderstorm areas upward currents of air with velocities of at least 8 metres per second (18 m.p.h.). Such currents prevent raindrops from falling, and Simpson supposes the drops to go through frequent repetitions of the cycle; growth, breaking up (with separation of electricity), fresh growth, and so on, at a nearly constant height in the atmosphere until the charge is so great as to produce at a certain level a gradient larger than 30,000 volts per cm., which he takes to be the electric strength of air. When this limit is reached, a lightning flash neutralises the accumulated charge over a limited area, and the process goes on repeating itself. There are various difficulties in the way of accepting this explanation as complete, but some represent our present ignorance rather than positive knowledge. We should like to know, for instance, whether vertical air currents such as Simpson postulates really do exist near the precise level where the air breaks down, also what the true nature of a lightning flash is, whether unidirectional or oscillatory, what charge passes, and what is the expenditure of energy. For all we know, the air may be in a strongly ionised condition, possibly even there may be separation of the constituent gases, and a potential gradient much under 30,000 volts per cm. may suffice to cause a discharge. In the meantime, Simpson's theory of thunderstorms had better be regarded as a hypothesis, but, unlike some hypotheses, it promises to be useful in suggesting promising lines for observation and experiment. The separation of electricity by the breaking up of raindrops may not play quite so fundamental a part as Simpson supposes. but assuming it to take place with natural rain, it can hardly fail to play an important part in thunderstorm phenomena.

The memoir as a whole is most original and suggestive, and is one on which the meteorological service of India deserves to be congratulated. As many readers of Nature are doubtless aware, Dr. Simpson's services have been lent by the Indian Government to the present British Antarctic Expedition, principally with the view of his studying electrical conditions in high latitudes, and we may, I think, entertain high hopes that the resulting increase of knowledge will be eminently satisfactory both to India and to this country.

C. Chree.

THE PREVENTION OF PLAGUE.

A MEMORANDUM on plague has recently been prepared by Dr. Newsholme, medical officer of the Local Government Board, and has been sent to the sanitary authorities of England and Wales, with a request that their officers should endeavour to secure the adoption of the suggestions contained therein. The memorandum gives an interesting conspectus of the essential features of the disease, and deals mainly with its methods of spread and the measures which, in the light of recent researches, must be taken for its prevention. Fortunately, plague, although a disease capable of manifesting itself as an epidemic of a widespread and virulent character, is now so well understood on its epidemiological side, that the direction which preventive measures should take is obvious. The situation may be summarised in the dictum—"no rats, no plague." Practically, however, the matter is perhaps not so simple as it may seem.

The first section of the memorandum describes briefly the symptoms in plague. The injected eyes and the thick, "drunken" speech are noted as characteristic signs of the disease. There is no mention, however, of the tendency to "shouting" delirium and the impulse to get out of bed and wander off, utterly heedless of their condition—well-known symptoms in the natives of India. The "acute" ward of a plague hospital is at times a very noisy place, and mild restraint requires to be put upon patients to prevent their unconscious excursions.

The "ambulant" form of plague is referred to, and it is stated that persons with this type of the disease may spread the infection. Spread of infection by such persons would seem, however, to be very doubtful, by direct personal contagion at least, and it is equally doubtful whether effective carriers of the disease in the sense of typhoid carriers exist. The evidence for the existence of such carriers is not satisfactory, and although the possibility of the occurrence of "pneumonic" carriers must be considered, the rarity of this type, at least in India, and its extreme fatality, considerably limit its importance from this point of view.

The statement that there is little or no liability to infection from contaminated food is a comforting one, and is justified by the accurate observations on the pathology of human plague made some years ago in Bombay by the Austrian Plague Commission, and by the results of experiments on susceptible animals.

The memorandum accepts in its entirety the results of the recent investigations of the Plague Research Commission, viz., that the sole infective agents in an epidemic of bubonic plague to be reckoned with are the infected rat and the infected rat flea—the former an indirect agent and the latter the immediate infecting agent. It follows that the measures suggested for attempting to stamp out the disease are directed solely towards the destruction of rats and their parasites. It has indeed been claimed that domestic

animals, such as cattle, pigs, fowls, ducks, &c., are susceptible to plague infection, but extensive experiments made by competent observers in several parts of the world completely agree in opposition to this belief.

In the memorandum the importance of preventing the access of rats to or their entrance into buildings is emphasised. It is pointed out that a cat in the house is a safeguard against domestic invasion by rats and mice, although it must be borne in mind that the cat is in some degree susceptible to plague. Major Buchanan, of the Indian Medical Service, has strongly urged the advisability of stocking the villages in India with cats as a preventive measure, but it must be said that no very definite evidence in support of the proposal has been produced.

With regard to the extermination of rats it is admitted that complete extermination is perhaps impossible. A material diminution in the rat population would undoubtedly lessen the spread of infection amongst them, but the fertility of the rat and the fact that it overruns the whole country in enormous numbers make the task of permanently suppressing the rat community in this country an extremely difficult one. It is certain that only a never-ceasing and complete organisation for rat destruction will appreciably reduce their numbers, and it is perhaps not sufficiently realised by some of the advocates of a general rat campaign that in order to be thorough and effective such a campaign would involve a most extensive and, in the aggregate, a most costly organisation. In this connection the experience of rat destruction gained in Japan is instructive. Kitasato has reported that in five years 4,800,000 rats were killed *in Tokio alone* at a considerable financial outlay, but that at the end of this time no appreciable decrease in the rat population could be detected. Kitasato attributed this to the circumstance that the rate of destruction, vigorous as it was, did not keep pace with the natural increase in the rat population. Recent experience in India appears to point in the same direction.

It is beyond question, however, that so far as plague prevention is concerned a great deal can be done in this country by diminishing or, preferably, abolishing rat infestation in human habitations and in their immediate neighbourhood.

G. F. PETRIE.

DR. THEODORE COOKE.

WE announced with regret last week the death, on November 5, of Dr. Theodore Cooke, C.I.E., formerly a member of the Bombay Educational Department. Born at Tramore, co. Waterford, in 1836, Dr. Cooke entered Trinity College, Dublin, where, after a distinguished career as a student, he graduated in 1859 in the faculties of arts and engineering. In the former faculty he was Hebrew prizeman, first honoursman, and senior moderator and gold medallist in science; in the latter he obtained special certificates in mechanics, chemistry, mineralogy, mining, and geology. Pursuing his profession as an engineer, he joined in 1860 the service of the Bombay, Baroda and Central India Railway, then under construction; during this service he built for the company the great iron bridge at Bassein. Five years later the Government of Bombay secured the services of the talented young engineer as principal of the Civil Engineering College, which later with widened scope became the College of Science, at Poona. The post proved congenial to Dr. Cooke; his wide and varied knowledge, with which were associated much tact and great administrative gifts, enabled him to fill it with signal success until he retired from India in 1893.

Throughout his service Dr. Cooke had taken a keen interest in botanical studies, and field-work connected therewith was one of his chief recreations. What he did as a pastime was, however, characterised by the thoroughness that marked his official work; he soon became a recognised authority on the vegetation of Bombay and Scinde, and it was only fitting that when, in 1891, the Botanical Survey of India was organised, Dr. Cooke should be placed in charge of the survey operations in western India. Encouraged thereto by Sir George King, then director of the survey, Dr. Cooke made preparations for the production of a "Flora of the Presidency of Bombay." Difficulties over which neither Sir George King nor Dr. Cooke had control at first prevented the realisation of the scheme, and when Dr. Cooke retired in 1893 his energies found an outlet in a post to which he was appointed at the Imperial Institute.

The difficulties that had stood in the way of the publication of a local flora of Bombay having at last been overcome, Dr. Cooke was able, some years later, to settle at Kew and commence the preparation of the work in the herbarium there. The first part was published in 1901; the seventh and concluding part appeared about two years ago. The work is marked by the thoroughness and attention to detail characteristic of all that Dr. Cooke did; nothing is taken for granted; every previous statement is carefully verified or refuted; and the "Flora" will remain a lasting memorial to Dr. Cooke's critical acumen, industry, and energy. On its completion Dr. Cooke continued to work in the herbarium with undiminished ardour, assisting as a volunteer in the preparation of the great "Flora Capensis," edited by Sir W. T. Thiselton-Dyer, until laid aside by the illness which has ended his career. Dr. Cooke, on whom his university had already conferred the degree of LL.D., was created a C.I.E. in 1891, and was a Fellow of the Linnean and the Geological Societies.

NOTES.

THE Nobel prize for chemistry has been awarded to Prof. Otto Wallach, professor of chemistry in the University of Göttingen.

WE regret to see the announcement of the death, on November 13, of Mr. W. R. Fisher, formerly assistant professor of forestry at Coopers Hill College.

THE Royal Geological Society of Cornwall at its annual meeting at Penzance on November 8 awarded Dr. George J. Hinde, F.R.S., the Bolitho gold medal for his valuable papers and services in connection with the geology of the county.

A REUTER telegram from Pisa states that on November 10, in the presence of King Victor Emmanuel and a Government Commission, Signor Marconi received wireless telegrams direct from Canada and Massowah by means of his extra powerful installation at Coltano.

MR. A. E. BROWN, secretary of the Zoological Society of Philadelphia, has died suddenly of heart disease in his sixty-first year. He was vice-president and curator of the Academy of Natural Sciences in the same city, and a frequent contributor of zoological and biological articles to various scientific journals.

DR. C. WILLARD HAYES, chief geologist to the U.S. Geological Survey, is now visiting Panama by the direction of President Taft to make a preliminary study of

geological formations in the "canal zone," with special reference to the excavations at the Culebra cutting. Upon the results of his investigations will depend the decision whether a geologist will be permanently assigned to assist the canal commission.

A REUTER message from Munich announces the election of the following corresponding members of the Munich Academy of Sciences:—Dr. F. G. Kenyon, director and principal librarian of the British Museum; Dr. L. Fletcher, F.R.S., director of the Natural History Museum, South Kensington; Principal Miers, F.R.S., the University of London; Dr. D. H. Scott, F.R.S.; Profs. Wilson and Osborn, Columbia University, New York.

PRIOR to the anniversary meeting of the Mineralogical Society in the Geological Society's rooms at Burlington House on Tuesday, November 15, Dr. Lazarus Fletcher, F.R.S., was presented with his portrait, painted by Mr. Gerald Festus Kelly, in recognition of the invaluable services he had rendered to the society during the past quarter of a century, the presentation being made by Prof. W. J. Lewis, F.R.S., on behalf of the members and other subscribers. For three years, 1885–8, Dr. Fletcher was president, and for twenty-one years, 1888–1909, general secretary, of the society, and it is to his genial and stimulating influence that its present prosperous condition is largely due. Dr. Fletcher resigned the secretaryship upon his appointment as director of the Natural History Museum.

A CAREFULLY planned effort is being made by the authorities of the American Museum of Natural History in New York to popularise the resources of that institution. On a recent afternoon they gave a reception to from 1500 to 1800 of the school teachers of the city, having invited the principal of each school and two delegates whom he should appoint. The programme of this "Teachers' Day" included a personally conducted tour of the building, an introductory address by the president of the museum, Dr. H. F. Osborn, and six ten-minutes' talks by experts, interspersed by orchestral music, and followed by tea in the ornithological hall. The object of the reception was to show the teachers of New York what the museum had to offer both for themselves and for the children in their classes.

DR. W. H. BREWER, professor emeritus of agriculture at the Sheffield Scientific School of Yale University, has died at New Haven from the infirmities of old age. He was born in 1828. Before his appointment to the Yale chair in 1864 he had been professor of chemistry and geology at Washington College, Pennsylvania, and professor of chemistry in the University of California. He became professor emeritus in 1903. He had served on several important Government commissions, and had been president of the Connecticut Board of Health, of the Connecticut Academy of Sciences, and of the Arctic Club of America. In an editorial note on his career, the New York *Evening Post* describes him as one of the fast disappearing representatives of a stirring type. It quotes from a friend who once spoke of him as an "eminent geologist, an expert mining engineer, an Arctic explorer, an art critic, an author, and a charming companion," and adds that, like Shaler and Holmes, he "was the product of no system other than that prescribed by his own capacity of learning, and perhaps for that very reason possessed a vitality and range which are seen but seldom in the younger generation."

AT the annual general meeting of the London Mathematical Society, held on November 11, the following were elected to be the council and officers for the session 1910–11 (the names of members not on the retiring council are printed in italic type):—*President*, Dr. H. F. Baker, F.R.S., *vice-presidents*, *Mr. J. E. Campbell, F.R.S.*, Major P. A. MacMahon, F.R.S., Sir William Niven, K.C.B., F.R.S.; *treasurer*, Sir Joseph Larmor, F.R.S.; *secretaries*, Prof. A. E. H. Love, F.R.S., Mr. J. H. Grace, F.R.S.; *other members of the council*, Mr. G. T. Bennett, Dr. T. J. I'A. Bromwich, F.R.S., Dr. W. Burnside, F.R.S., Mr. E. Cunningham, Mr. A. L. Dixon, Dr. L. N. G. Filon, Dr. E. W. Hobson, F.R.S., *Prof. H. M. Macdonald, F.R.S.*, and Dr. A. E. Western.

VERY great vigour has characterised the conduct of the Tacubaya Observatory of late, and therefore the severe loss the institution has suffered by the death of the director, Dr. F. Valle, will be keenly felt, for he made the observatory a centre for scientific activity throughout all Latin America. Dr. Valle played a foremost part in promoting scientific usefulness and maintaining an efficient standard throughout the Republic of Mexico. The "Annuaire," for which he was mainly responsible, appeared with great regularity, and supplied a mass of information connected with geodesy, meteorology, and physics that would be particularly useful in the society in which it circulated, while the articles on astronomy quickened local and popular scientific effort. But of greater importance in general, and on what the reputation of the late director will rest, was his ardent prosecution of the work of stellar photography in connection with the *Carte du Ciel*, the observatory being responsible for the zone 10°–16° south declination. When the last report was issued, only 22 fields remained to complete the 1200 for the catalogue, and these must have long since been supplied. No fewer than 800 plates had been measured, and the catalogue plates were being actively pushed forward. Such activity contrasts very favourably with the results obtained at some observatories engaged on the southern zones, and the zeal displayed is the more commendable, as it is known Dr. Valle had to contend with very great difficulties in regard to the figure of the object-glass of his photographic refractor. Dr. Valle did not only measure his plates, but he used his meridian circle vigorously for determining the position of standard stars used in the reduction of the photographic plates. Add to this record the work of the observatory in spectroscopy, magnetism, seismology, and meteorology, and it will be admitted that Dr. Valle's energy went far to remove the stigma of indifference and lassitude which at one time was inclined to rest on the observatories of Spanish America.

THE account of the work of the Port Erin Biological Station given by Prof. W. A. Herdman to the Liverpool Biological Society on November 11 shows that the station continues to develop. It is expected that the much needed extensions now in progress will be completed and equipped by Easter of next year. During last summer vacation Prof. Herdman, Dr. Dakin, and Dr. Roaf conducted, for the first time, a valuable course of work in the science of oceanography (including hydrography and planktology). The work consisted partly of lectures and demonstrations in the biological station, partly of collecting and observing work on the seashore, and partly of expeditions at sea in the steam yacht *Ladybird* and in the Lancashire Sea Fisheries steamer. The operations of the fish hatchery at the station have resulted in the hatching and setting free at sea of upwards of 8,000,000 plaice fry and more than 5000 lobster larvæ—a substantial advance upon the work of any previous year. Plankton observations were carried out on the same lines as in the previous three years, three collections being made twice a week in the sea off Port Erin the whole year round. During July Prof. Herdman

took a series of vertical plankton hauls from various deep localities off the west coast of Scotland. A comparison of the collections show (1) that there is a constancy year after year in the nature of the plankton at certain localities, and (2) that some of the localities, not very far apart, differ considerably from one another in the nature of their plankton at the same time of year (July).

THE general committee of the Mansion House fund for providing a memorial to King Edward in London has had under consideration numerous proposals as to the form the memorial should take. The only decision which has as yet been arrived at is that, apart from the provision of a larger memorial of his Majesty, a statue of King Edward VII., with suitable accessories, be erected in some prominent and appropriate position in London, and that a fund be immediately opened for the purpose. Other schemes are still under consideration. Originally 164 proposals were received by the committee, but, according to the daily papers, these have been ruled out, with a few exceptions, as unsuitable or impracticable. The general committee has still to decide finally; but among schemes recommended to them by the executive committee are Lord Esher's proposal for an historical museum in London on the lines of the Musée Carnavalet in Paris. Secondly, the scheme of Lord Avebury for the building of a great hall for the University of London, to be used for degree and ceremonial purposes, and also for examinations. Thirdly, Lord Northcote's suggestion that a portion of the fund should be devoted to a scheme "for the protection of human life in the tropics by a great extension of that campaign against tropical disease which has already abated so largely the sum of human suffering." This last proposal has the support of the Society of Tropical Medicine and Hygiene, and a letter, signed by Prof. Ronald Ross, F.R.S., and other officers of the society, outlining the valuable work for the Empire which could be done by such an endowment of the study and prevention of tropical diseases, appeared in the *Times* of November 5. Lord Rosebery, as Chancellor of London University, has, in a letter to Lord Avebury, expressed his hearty approval of the scheme put forward by Lord Avebury.

ON November 8 Major Sykes delivered an interesting lecture to the Royal Geographical Society describing two short journeys which he took recently in north-eastern Persia the ancient Parthia, and Hyrcania. This district has always been one of special interest to the historian. It formed part of the patrimony of the earliest Persian kings; in it originated both the religion of Zoroaster and the Parthian dynasty, which measured its strength successfully with Rome; it has always been the debatable land on the border between Iran and Turan; and now it seems within measurable distance of falling, finally, into the possession of Russia, without any of the clamour, nay, danger, of war which such an advance of the Muscovite would have caused in England a few years ago. Such are the ways of high politics. The cities of north-eastern Persia are interesting also. Meshhed is a great centre of caravan-routes; ancient Nishapur is renowned as the birthplace and abiding-place of Omar Khayyâm; Turshiz is the traditional town of Zoroaster, where the great prophet converted Vishtâspa the king and planted the sacred cypress; Budjurd and Astrabad are interesting as really Turanian rather than Iranian towns. The dividing line between Hyrcania and Parthia was never drawn definitely. In the inscription of Darius the Great at Bisitûn (Behistun), the lands of "Parthva and Varkana" are mentioned together. The name of Hyrcania (Varkana) survives in that of the modern river Gurgân. Major Sykes had previously visited the valley of the Atrek, in which Budjurd lies. His route on this journey was taken from Meshhed to Budjurd, thence to Astrabad, and back by way of Shahrud, Subzawar, and Nishapur (the well-known old trade-route) to Meshhed. On the way he made several interesting explorations, and identified some ancient sites, notably that of Paras, which is probably the ancient Parthian capital. On his second journey he went to Nishapur and Turshiz. At Nishapur he identified the sites of several ancient cities which have been built near the spot from the original Niv-Shapur of Sapor I. to the mediæval Nishapur of Omar Khayyâm and the entirely different modern town. At Turshiz Major Sykes also made interesting discoveries.

IN spite of having presented his unrivalled collection to the nation, Lord Walsingham, as evident from a paper on Madeiran Tinerinæ in the November number of the *Entomologist's Monthly Magazine*, continues to devote attention to his favourite Micro-Lepidoptera. Two new species are described in this communication.

WITHERBY'S *British Birds* for November contains a long list of birds marked in the British Isles which have been recently recovered in various places, either at home or abroad. Among the items may be noted a teal marked in Essex in February and taken off Schleswig in August, and a tern ringed in Cumberland in July and captured south of Oporto in September.

IN a paper on the tooth-billed bower-bird (*Scenopœetes dentirostris*) published in the *Emu* for October Mr. S. W. Jackson states, as the result of continued observation, that, as a rule, during the height of the breeding season these birds do not visit their play-grounds or indulge in mimic vocalisation in the daytime, but reserve the latter performance for the periods before sunrise and after sunset, when they are in the tree-tops. During the nesting season the play-grounds are silent, unoccupied, and, most significant of all, untidy.

To the November number of *Pearson's Magazine* Mr. Walter Brett contributes an appreciative notice of the bird groups mounted in the Natural History Museum at New York. According to the author's own words, the birds in these groups "positively breathe with life. Their pose is natural; their surroundings are true to nature; their throats almost tremble with the song one expects to hear. And the reason of this is that these birds are life studies, scientifically correct as well as artistically perfect. The visitor knows they are stuffed only because he is aware that they are in a museum, not in an aviary." The article is illustrated with reproductions from photographs of several of the groups.

No. 1766 of the Proceedings of the U.S. National Museum is devoted to an account, by Miss Rathbun, of a collection of stalk-eyed crustaceans from the coast of Peru and adjacent parts of South America. The most notable additions to the fauna include a small crab of the genus Dromidia—the first of its group from western South America—and *Panopaeus bermudensis*, previously known from the Atlantic, while examples of two species hitherto represented by the types were also obtained. A noticeable feature is the abundance of Xanthidæ and Inachidæ and the scarcity of Parthenopidæ and shrimps of all kinds. Many of these Peruvian crustaceans, especially hermit-crabs, are used either as food or for bait.

AT the commencement of a review of the species of venomous toad-fishes of the genera Thalassophryne and Thalassothia, published as No. 1765 of the Proceedings of the U.S. National Museum, Messrs. Bean and Weed state that these fishes differ from all other members of the class by possessing grooved or perforated spines, analogous to

the fangs of venomous serpents, for introducing the poison they secrete into the bodies of their victims. In a specimen of *Thalassophryne reticulata* examined by the authors the poison-sac was found to occupy the whole length of the under side of the spine. The position of the sac is such that any pressure tending to drive the spine into the skin of another animal would produce a pressure on the sac, and thus inject the poison with considerable force into the wound.

THE ova and larvæ of teleostean fishes taken at Plymouth in the spring and summer of 1909 form the subject of the chief article in the Journal of the Marine Biological Association (October). The work was specially directed to practical questions connected with the fishing industry, such as the location of spawning areas, the duration of the spawning period, and the relative extent of the breeding of various kinds of fishes in the Plymouth area rather than to details of purely biological interest, and accordingly the descriptions of the eggs and larvæ forming the subject of the article bear special reference to the means of ready identification at different stages of development. A striking feature in the collection of pelagic eggs was the overwhelming preponderance of those of non-marketable species, such as rockling, rock-wrasse, boar-fish, and dragonets. It may be assumed, if sufficient samples be taken, that the relative abundance of eggs in the plankton affords a trustworthy index to the proportionate numbers of adult fish at the spawning season, and it may therefore be expected that in inshore areas such eggs should be largely those of rockling and wrasse. But this does not explain the predominance of dragonets, boar-fish, &c., over whitings, dabs, plaice, and soles. Although the latter are the objects of attention on the part of trawlers, it is still an open question to what extent the present state of affairs may be attributed to trawling.

IN the *Biologisches Centralblatt* (October 15) is published the first portion of an article, by Prof. K. Goebel, on sexual dimorphism in plants, discussing the extent to which diœcious plants are modified apart from the sexual organs. Examples of specific differences in seed plants are rare. *Cannabis sativa* is often quoted as a good example, although the author doubts if there is much distinction in a præfloral stage; he also questions whether it is possible to distinguish staminate and pistillate specimens of Cycas, Taxus, and Juniperus when not in flower. Amongst cryptogams better examples occur, notably in the case of such liverworts as *Symphyogyne leptothele*, which is figured. The fundamental reason for the differences lies in the necessity for providing more nourishment for the products of the egg cell, and this also explains the positions of the sexual organs in monœcious plants.

THE current number of *Tropical Life* (No. 9, vol. vi.) contains several articles on cotton cultivation both in the British Empire and the United States. In Egypt, Mr. Foaden points out, cotton occupies from one-half to one-third of the total acreage of cultivated land in those provinces where the conditions are suited to its growth, while the value of the crop is from 25,000,000*l*. to 30,000,000*l*. annually. Unfortunately, there has been a gradual fall in yield per acre during the past few years, the cause of which has been variously attributed to a rise in the subsoil water brought about by increased irrigation, to an increase in insect pests, and to soil exhaustion. Though the fertility of the Nile Valley is proverbial, the soils are usually deficient in nitrogen; crops show remarkable increases when nitrate of soda is applied or when a crop of clover—berseem—is ploughed in.

IN the current number of the *Fortnightly Review* Mr. J. Saxon Mills writes on the production of sugar from sugar beet, which he regards as one of the most hopeful schemes yet suggested for the benefit of rural districts. All the arguments in favour of the crop are set out concisely, and some very persuasive statistics are given. Field trials in Lincolnshire, Suffolk, Essex, and at Newnham Paddox have shown that crops varying from 15 to 20 tons per acre can be obtained containing 16 to 18 per cent. of sugar, while the Continental crops are lower both in quantity and in sugar content. Indeed, sugar beet is actually grown on a commercial scale in parts of the eastern counties, but is shipped to Holland to be worked up in the Dutch factories. It is contended that factories would prove highly advantageous in English country districts, and would also prove a remunerative investment. As several factories are already being started in England, it ought not to be long before very definite information is forthcoming on this question.

THE report on the Experiment Station, Tortola, Virgin Islands, for 1909–10, is to hand, and records certain improvements and additions to the station in connection with the sugar and cotton work and the water supply. The export trade in sweet potatoes and limes shows signs of increasing, while it has also been shown that a limited quantity of cacao could be produced for export. The cotton industry received a check owing partly to a fall in price and partly to bad weather; early planting is recommended as an improvement in cultivation. The report on the Botanic Station, Agricultural School and Experimental Plots, St. Lucia, 1909–10, shows that continued and steady progress is being made. During the year no fewer than 77,557 plants were sent out for distribution from the station, against 43,492 for the previous year. A scheme for prize-holdings competitions has been introduced, and will, it is hoped, raise the general level of cultivation.

IN a paper read at the November evening meeting of the Pharmaceutical Society, Prof. H. G. Greenish and Miss D. M. Braithwaite described a method by which the presence of the drug-room beetle (*Sitodrepa panicea*) may be readily detected in powdered drugs. The quantity of beetle present in an infested drug is so small that its direct examination under the microscope is practically impossible, and it is therefore necessary to separate the particles of insect from the drug before they can be observed. The process of separation devised by the authors is dependent upon the fact that the hardened parts of the mature beetle are of such a highly chitinous character and so extremely resistant to the action of acids, alkalies, and oxidising mixtures that it is possible to destroy the organic matter of the powdered drug without destroying the beetle. It is possible by means of the process described to detect particles of beetle in a powdered drug containing 0·00001 gm. of beetle in 5 gms. of powder. By the use of this method it can be shown whether a powdered drug is prepared from "worm-eaten" or sound material. In the course of their investigations the authors found that while the larvæ of the beetles undoubtedly ingest considerable quantities of starch, only a small proportion of this appears to be digested. It seems probable that the substances chiefly utilised as nutriment by the larvæ are not carbohydrates, but nitrogenous substances, such as the remains of protoplasm, &c.

BLACKHEAD is a highly infectious disease of turkeys prevalent wherever they are domesticated, and causes great financial loss each year. The symptoms are voluntary isolation, stupor, loss of appetite, drooping of the wings,

and emaciation; the disease is characterised by pathological changes in the cæca, intestines, and liver, while there are invariably present in the organs encysted stages of a coccidium, and also an amœba known as *A. meleagridis*. In a long Bulletin issued by the Agricultural Experiment Station of the Rhode Island State College Drs. Cole and Hadley give a detailed summary of the work so far done on the disease, and add a number of observations of their own. Although but little advance is recorded in the methods of prevention and treatment, the bulletin will be found very useful to those interested in diseases of birds, both by reason of its completeness and for the evidence it offers that the cause is a coccidium.

THE United States laws dealing with commercial fertilisers go further than our own in that they require the name of the firm to be published along with the analytical data dealing with the manures and feeding-stuffs supplied. Bulletin 141 of the Purdue University Agricultural Experiment Station gives the results of analysis of several hundred fertilisers and feeding-stuffs, together with the guarantee and the name and address of the manufacturer. Any case of fraud is thus at once exposed. The law is fully explained in the bulletin, and several illustrative cases are quoted. There are also tables showing the average composition of normal feeding-stuffs, and of the materials used as adulterants. Altogether, the bulletin gives a very good idea of the work of an agricultural analyst in the United States. A smaller bulletin on the same lines is sent us by the West Virginia University Agricultural Experiment Station.

IN one of a series of papers on the foraminifera of the shore-sands of Selsey Bill, Sussex, Messrs. E. Heron-Allen and A. Earland have described the forms derived from Cretaceous sources (Journ. R. Microscopical Soc., 1910, p. 401). In all cases these have been compared with specimens obtained from the hollows of flints in the same deposits; 118 species are identified, some of which are new to the records from the Upper Chalk. Mr. Heron-Allen offers a copy of a privately issued paper on Chalk foraminifera, printed in 1894, to any worker who may apply for it (address: Large Acres, Selsey). This earlier paper contains complete directions as to preparing material from the Chalk, as well as records of a number of species found at Twyford, many of which were previously known only in Cainozoic strata. It is pleasant to see that the veteran Mr. Joseph Wright, of Belfast, remains an active adviser on the work published in 1910.

COPIES have reached us of the valuable meteorological charts of the North Atlantic and North Pacific Oceans for December, and of the South Atlantic and South Pacific for the season December, 1910 to February, 1911, issued by the U.S. Weather Bureau. In the North Atlantic chart Prof. Moore continues the useful practice of exhibiting, by daily synoptic weather charts, specimens of the typical cyclonic storms which occur in that month. One of these disturbances, which was central near the Azores on December 18, 1909, moved quickly across Great Britain to the North Sea. The synchronous chart of December 21 shows that another storm dominated the entire northern part of the ocean, that typical cyclonic circulation prevailed from the American to the European continent, and that its disturbing influence was felt so far south as Madeira.

AN interesting application of the dilatometric method to the study of the polymorphism of the alkali nitrates is described by Prof. Bellati and Dr. Tinazzi in the *Atti del Reale Istituto Veneto*. It is shown that ammonium nitrate undergoes an abrupt expansion at 35°, a contraction at 86°, and a second expansion at 125°, corresponding with the three transition-points of the four modifications of the nitrate. Potassium nitrate undergoes an abrupt expansion at 127°, rubidium nitrate at 161°, cæsium nitrate at 148°, and thallium nitrate at 73° and 142° C.

IN reference to Dr. Baker's remarks on the Theory of Numbers at the Sheffield meeting of the British Association (NATURE, October 20, p. 514), Dr. Vacca, of Genoa, sends us the following quotation from Euler (Nov. Comm. Petr., vol. xvii., 1772, p. 25):—

"Non dubito fore plerosque, qui mirabuntur, me in huiusmodi questionibus evolvendis, quas nunc quidem summi geometrae aversari videntur, operam consumere; verum equidem fateri cogor, me ex huiusmodi investigationibus tantumdem fere voluptatis capere, quam ex profundissimis geometriae sublimioris speculationibus. Ac si plurimum studii et laboris impendi in quaestionibus gravioribus evolvendis, huiusmodi variatio argumenti quamdam mihi haud ingratam delectationem affere solet."

WE learn from the *Engineer* for November 11 that the Metropolitan Water Board intend to instal a battery of Humphrey gas pumps for the reservoir which is being constructed in the Lea Valley, near Chingford. A total pumping capacity of not fewer than 180 millions of gallons in twenty-four hours is required, made up of one unit of 20 and four units each of 40 million of gallons. It is understood that the Pump and Power Company, Ltd., offered to supply and erect on foundations provided by the Board five pumps of these capacities, together with a Dowson producer gas plant and all accessories, including two electrically driven compressors for starting purposes, for the sum of 19,388*l*. The guaranteed fuel consumption is not to exceed 1·1 lb. of anthracite coal fed into the producers per actual horse-power hour when working at the normal full load during an official trial of six hours' duration. The head to be pumped against is 29 to 30 feet, including friction. Thus a power of about 250 pump horse-power is required in each of the larger units. The conditions are ideal for the Humphrey gas pump, but as the power is larger than anything yet attempted by Mr. Humphrey, the results of the experiment will be awaited with considerable interest. At any rate, the Water Board cannot be accused of being behind the times.

AN article in the *Builder* for November 12 deals with a novel type of timber construction evolved by Mr. Otto Hetzer, of Weinar. In this new method the cross-sections of timber beams are adapted to actual stresses as in the case of riveted iron structures, and this is carried out by means of a composite beam with variable cross-sections in each given portion. A special glue being required, capable of forming an inseparable whole out of a number of composite parts, Mr. Hetzer seems to have succeeded, after many years of work, in producing one which possesses the required rapidity of binding, resistance against atmospheric influences, and the property of increasing hardening. The Hetzer compound beams are composed of three longitudinal layers, the uppermost of which is a wood characterised by a particularly high compressive strength (such as red beech), and the lowermost of a wood of great tractive strength (such as pine); the central portion need not be of any specially resisting material. An upward parabolic curvature is imparted to the central wood, so that in the central cross-section, submitted to the highest stresses, the whole of the deflection thrust is dealt with by this parabolic core and the lowermost layer. Satisfactory tests of these beams have been made at the Institute of Charlotten-

burg. Photographs of a bridge and several large roofs constructed under Hetzer's system are included in the article.

One of the chapters in the latest volume of "The Cambridge Modern History" (to be published on December 8), dealing with "The Scientific Age," is written by Mr. W. C. D. Whetham, F.R.S., who has undertaken the important and difficult task of surveying the trend of modern science in all its various departments. In this chapter will be found considerations of the Darwinian hypothesis, of evolution and religion, of electrical invention, of bacteriological treatment of disease, and other phases of modern scientific progress.

The October issue of *The Central*, the organ of the Old Students' Association of the City and Guilds of London Central Technical College, maintains the high standard previously reached by this periodical. The number is well illustrated, the frontispiece being an excellently reproduced portrait of Prof. W. J. Pope, F.R.S. Among articles contained in this issue may be mentioned those by Mr. H. Clifford Armstrong on steel making; Messrs. W. Gore and D. Halton Thomson on rainfall, steam-flow, evaporation, and reservoir capacity; Mr. Howard Mayes on boiler management; and Mr. A. G. T. Glaisby on birds and photography.

OUR ASTRONOMICAL COLUMN.

Discovery of a Comet.—A telegram from the Kiel Centralstelle announces the discovery of a new comet by Dr. Cerulli on November 9. Its position at 8h. 20·8m. (Rome M.T.) was R.A.=3h. 38m. 36s., dec.=8° 43′ 20″ N., and its daily motion amounted to −8s., −19′. The magnitude is given as 10·2, and the comet's position lays about half-way between, but slightly below the line joining, ζ and λ Tauri.

Metcalf's Comet (1910*b*).—Dr. Ebell publishes a continuation of his ephemeris for comet 1910*b* in No. 4452 of the *Astronomische Nachrichten*. This ephemeris covers the period November 13 to January 4, and shows that the comet is now moving slowly, in a north-easterly direction, through Serpens towards Corona; on December 8 it will be about ½° north of δ Coronæ, and of the twelfth magnitude.

Recent Fireballs.—A large number of fireballs have been observed during the last few weeks. The records of their appearance are not, however, sufficiently full and accurate to enable their real paths to be computed except in the cases where the objects were seen by capable observers.

The majority of the brilliant meteors have evidently belonged to a shower of Taurids, which is often very active in the first half of November, and is notable for the magnitude and conspicuous aspect of its members.

At 10h. 24m., November 9, one of the most interesting of the fine meteors recently seen was not a Taurid, but directed from a radiant at 312°+11° in the western sky. It passed from over a point east of Yeovil to west of Horsham at heights of 62 to 32 miles. The motion was unusually slow, viz. about 12 miles per second. The meteor sailed through the air in an apparently serpentine course, its sluggish, wriggling flight being specially noticed by observers at Bristol and other places, who mention it as quite an exceptional feature. There is no known shower at 312°+11° in November, but on November 2, 1801, Mr. Denning recorded a brilliant meteor close to its radiant, estimated at 311°+11°.

Solar Activity and Terrestrial Temperatures.—An important paper on the effect of solar changes on terrestrial temperatures is published by Mr. W. J. Humphreys in No. 2, vol. xxxii., of the *Astrophysical Journal*.

Mr. Humphreys accepts the interrelation of magnetic, and auroral, disturbances and sun-spot changes as established, and points out that terrestrial temperatures and rainfall are observed with sufficient accuracy to justify an examination of their relation to solar activity. Further, he considers rainfall dependent upon temperature, which is more accurately measurable, and so considers only the latter.

Taking Abbot and Fowle's conclusion that sun-spot maxima are accompanied by terrestrial temperature minima, and *vice versa*, the average range being 1° C., he points out the practical importance of a fuller knowledge of the nexus between these phenomena.

His conclusions, stated briefly, are that at spot maxima the solar atmosphere is more fully charged with "dust" (*i.e.* any particles capable of reflecting and scattering light), and therefore, owing to selective absorption, the proportion of ultra-violet radiations finally escaping will be diminished. Ultra-violet radiations acting on cold, dry oxygen, such as exists in the earth's upper atmosphere, produce ozone, therefore at spot maxima the amount of ozone will be less.

Further, it has been shown that ozone absorbs a much greater proportion of the earth-reflected radiations than of the incident solar radiations. Thus at spot maxima, with less ozone, more heat will escape, and a lower temperature ensue; the converse explains the observed rise of temperature at spot minima.

This process is complicated by many factors, such as the increase of ozone-producing auroræ at spot maxima, but Mr. Humphreys suggests that the observed change in terrestrial temperatures may depend largely, if not wholly, upon the selective absorption of the direct solar and the terrestrially reflected thermal radiations by the changeable amount of ozone in our upper atmosphere.

Stars having Peculiar Spectra, and New Variable Stars.—Circulars 158 and 159 of the Harvard College Observatory contains lists of newly discovered variable stars and stars having peculiar spectra. In No. 158 thirty-eight new variables, chiefly discovered by Mrs. Fleming, are tabulated, and there is also a list giving the positions, magnitudes, &c., of nineteen stars of which the spectra exhibit various peculiarities. Ten of these are of type vi., three are of type v. with bright lines, four are gaseous nebulæ, and in the remaining two Hβ is bright. In the spectrum of the ninth-magnitude star DM.−14° 5265 the bright line appears to be of slightly greater wave-length than Hβ, but is not the 5007 nebula line, and on a later photograph there is a trace of a bright line on the less refrangible edge of the dark Hβ; it is suggested that in this spectrum the bright line may be variable.

No. 159 contains a list of fifteen new variables discovered on Nos. 7, 10, 16, and 19 of the Harvard Map, and the usual analytical table shows that 0·41 of the probable variables on map 19 yet remain to be discovered. It is also stated that the very red star +46° 1817 apparently varies very irregularly.

The Discovery of Neptune.—No. 1954 of *La Nature* contains the complete text of the letter in which Leverrier sent to Dr. Galle the results which led to the visual discovery of Neptune. It is stated that the first time the whole of this historic document has been published is in a recent article by Dr. See in *Popular Astronomy*, and it is suggested that the proper place for the original would be in the museum of the Paris Observatory.

Variable Stars in the Orion Nebula.—No. 4451 of the *Astronomische Nachrichten* contains a list of eleven more stars, in the nebula of Orion, which are apparently variable. The number of known variables in this nebula now amounts to 156.

THE BANQUET TO JUBILEE PAST-PRESIDENTS OF THE CHEMICAL SOCIETY.

The council and fellows of the Chemical Society honoured five of their past-presidents who had completed their jubilee as fellows by entertaining them at a banquet at the Savoy Hotel on Friday, November 11. A large gathering numbering 250, including the Duke of Northumberland, the Postmaster-General, the presidents of the French and German Chemical Societies, and no fewer than eleven past-presidents, was presided over by Prof. Harold B. Dixon, F.R.S., the president.

The names of the past-presidents who were being honoured were:—

	Elected	President
Prof. William Odling, F.R.S. ...	1848	1873–5
The Rt. Hon. Sir Henry E. Roscoe, F.R.S.	1855	1880–2
Sir William Crookes, O.M., F.R.S.	1857	1887–9
Dr. Hugo Müller, F.R.S. ...	1859	1885–7
Dr. A. G. Vernon Harcourt, F.R.S.	1859	1895–7

Unfortunately, Sir Henry Roscoe was absent through illness.

After the loyal toasts had been duly honoured, the president gave that of the "Past-presidents who have completed their Jubilee of Fellowship." He referred to the personalities of the jubilee past-presidents, and to the particular work in which each was more especially distinguished: Sir Henry Roscoe, for his research on vanadium and as a pioneer educationist; Sir William Crookes, for his discovery of thallium, his researches on the rare earths, the genesis of matter and diamonds, and his brilliant discoveries in physics; Dr. Hugo Müller, for his researches on cellulose and discoveries in connection with printing; Dr. Vernon Harcourt, for his researches on the rate of chemical change and his work as an enthusiastic teacher; and Prof. William Odling, the doyen of chemistry, to whom all chemists will find it difficult to fathom their debt of gratitude.

In replying to the toast, Sir Henry Roscoe, whose speech was read by the president, drew on his reminiscences of the thirty-one past-presidents of the society, all of whom with the exception of two he had known, and of his association with the society.

Sir William Crookes sketched the steps by which he was led to the discovery of radio-activity. He stated that no law is more certain than the law of change. Radium has shaken our belief in the conservation of substance, the stability of the chemical elements, the undulatory theory of light, and the nature of electricity; it has revived the dreams of alchemists, and has cast doubt upon the very existence of matter itself. Physicists are beginning to say that there is no such thing as matter; that when we have caught and tamed the elusive atom and have split it into 700 little bits these residual particles will turn out to be nothing more than superimposed layers of positive and negative electricity. Speaking of the War Office Committee of which he was a member, he stated that what our country now most urgently requires is "brain-craft," the master of "hand-craft," and researchers who will cultivate chemistry for its own sake.

Dr. Müller commented on his association with the Chemical Society, on its rapid growth and increasing activity.

Dr. Harcourt referred to the influence of the growth of chemistry upon the teaching of the science as a part of general education, and to the importance in education of a knowledge of the general results of scientific inquiry and of some insight into the methods by which such knowledge has been gained. He mentioned the difficulty which the teacher of chemistry finds in keeping himself abreast of his subject, and the danger of teaching the latest hypotheses to students who are only studying science as a part of education and chemistry as a part of science, if it mislead them into believing that, because they have gained the latest lights, they have a thorough grasp of the science.

Prof. Odling referred to his connection with the four past-presidents who, with him, were being entertained, and with many of the older chemists, and of the association of Oxford University with the society.

Sir Edward Thorpe proposed the toast of the honorary and foreign members, which was replied to by Prof. Haller, president of the French Chemical Society, and Prof. Wallach, president of the German Chemical Society. At the conclusion of his speech Prof. Haller presented, on behalf of his society, a silver medal of Lavoisier to each of the jubilee presidents in honour of the occasion.

The last toast of the evening, that of "The Guests," was prooosed by Sir William Tilden and acknowledged by the Duke of Northumberland, president of the Royal Institution of Great Britain, Mr. H. L. Samuel, the Postmaster-General, and Herr Generaldirektor S. Eyde, of Christiania.

THE INTERNATIONAL AGROGEOLOGICAL CONGRESS AT STOCKHOLM.

A FEW months ago (August 4) we reviewed the proceedings of the first International Agrogeological Congress, held at Budapest in 1909. The second was held this year simultaneously with the International Geological Congress at Stockholm, as an experiment. It was well organised by the local committee and well attended, the membership numbering about 160. The sessions were arranged to allow the frequent attendance of members at the geological meetings in which they were likely to be interested. But it seems to have been recognised by most that the bonds of association between the two congresses were not so close as to render it necessary, or even desirable, that they should be held at the same place and time; and it was decided by the council that the next meeting should take place independently at St. Petersburg four years hence.

A prominent feature in connection with the congress was the very interesting exhibition of specimens, maps and instruments illustrating the science of the soil, which was brought together in the rooms of the Technical School, 44 Mästersamuelsgatan. The Swedish exhibits, which naturally formed the greater part of this collection, included sample-sections of the typical soils and subsoils down to the underlying strata from which they were derived. The sections of peat-mosses which showed changing conditions of accumulation were particularly noteworthy. Excursions were made, both during and after the congress, through selected districts and to the chief agricultural stations, thus enabling the visitors to appreciate the local methods of practical research, as well as to gain personal knowledge of Swedish agricultural conditions.

The papers read at the meetings were grouped together by their subject-matter, so that each session was devoted to the discussion of a separate problem. As was to be expected from the earnestness which has been thrown into the study of soils in Germany, most of the papers were given in German. Indeed, hardly any other language was used at the sessions. At the opening meeting on the morning of August 17, Prof. Gunnar Andersson delivered his instructive presidential address on "The Swedish soil-types and their distribution," in which the geological bearings of the soil-study were allowed a prominence which they rarely attained in the subsequent discussions. At the afternoon session the 'leit-motif' was "The mechanical analysis of soils," with illustrative papers by Dr. A. Atterberg (Sweden), Prof. P. Vinassa de Regny (Italy), and Dr. W. Beam (Egypt).

At the subsequent sessions, on August 18, 19, 20, 22, and 24, the following were the principal subjects of discussion:—"Colloids of the soil," introduced by papers by Prof. E. Ramann (Germany) and Dr. D. J. Hissink (Holland); "Preparation of extracts of soils for chemical analyses," after papers by Prof. A. de Sigmond (Hungary), Prof. A. Vesterberg (Sweden), and Prof. A. Rindell (Finland); "Nomenclature and classification of soils," with papers by Prof. E. W. Hilgard and Prof. R. H. Loughbridge (California), Prof. P. Kossowitsch (Russia), M. Béla de Inkey (Hungary), and Dr. B. Frosterus (Finland); "Systematic soil-surveying," with papers by Dr. K. O. Björlykke (Norway), Prof. K. Gorjanovič-Kramberger (Croatia), and Prof. F. Sandor (Croatia); "The analyses of peat soils," with papers by Dr. E. Haglund (Sweden) and Dr. H. von Feilitzen (Sweden). There were a few other papers, chiefly on the chemical side of the subject, which did not fall under the above headings, among them being an interesting general account of the soils of Egypt, by Dr. W. Fraser Hume.

As a merely personal impression of the proceedings from a geologist's point of view, it may be remarked that, with the rapid advance of specialisation in the study of soils, the connection of the subject with geology seems to have become more remote. It was only in the papers dealing with the mapping of soils that geological considerations were brought into prominence, and even then only as a basis for specialised classification. For the rest, it was toward physics, chemistry and plant-physiology that the new methods of research approximated. The major part of the papers dealt with the laboratory treatment of soils, mechanically and chemically, and with the

resultants of the varied treatments. In the process of dismemberment it must often happen that the true individuality of a soil is lost, so that schemes of laboratory classification sometimes arbitrarily separate agricultural similars and unite agricultural discordants. This was recognised in several of the discussions, and the students of the soil are now fully alive to the complexity of the problems needing investigation. In the opportunity afforded for comparing and criticising the diverse methods of research the congress was eminently successful; and on the social side it was wholly pleasurable.

EDUCATION AT THE BRITISH ASSOCIATION.

The presidential address this year was devoted to the topic of university education. Readers of Nature have already had an opportunity of reading Principal Miers's suggestive discussion of the relations of teachers and pupils at school, and of the change of method which should differentiate university from school education. Incidentally, the address raised the very practical question of the present overlapping of the two, and led to the appointment of a research committee, with the president as chairman, to investigate the subject and to report at Portsmouth next year.

The presentation of the reports of the Section L research committee on mental and physical factors involved in education, and of the committee of Section H on the establishment of a system of measuring mental characters, was made the occasion for a joint session of the two sections for the discussion of research in education. In the report of the committee of Section L the gradual integration of a science of education, drawing its data, as Prof. Schuyten wrote, from hygiene, anthropology, physiology, normal and abnormal psychology, pedagogy, and sociology, and yet with a common centre of reference and an inner coherence which set it apart from each of these related sciences, was indicated. The work in psychopedagogy now carried on in this country was briefly reviewed, and it was shown that, in spite of the lack of funds which was everywhere reported, researches were on foot in at least ten university centres. Prof. Green in his introductory remarks showed how poorly off we are in this respect in comparison with such countries as Belgium, France, Germany, the United States, and even with Russia, where the War Office, in discharging its responsibility for the education of the children of officers, maintains a professor and a laboratory for research work alone. He also urged the importance of training for researchers in this as in all other branches of specialised research, a point which was subsequently taken up by Dr. C. S. Myers and other speakers. Prof. Findlay explained how the university departments were in this matter sent from pillar to post, Treasury grants being refused on the ground that the Board of Education always looked well after their own, while the Board, on the other hand, in set terms disavowed all responsibility for research work. The position, as the president said, is "disgraceful."

A typical illustration of more purely pedagogical research was contributed by Dr. T. P. Nunn in his sketch of the methods of algebra teaching worked out in the demonstration schools attached to the London Day Training College. The old theory of algebra, associated with the name of Euler, in which the symbols are regarded merely as numbers—"a large number of numbers"—has given place to the view of Chrystal and others, to whom algebra is a systematic science capable of development from its own axioms. The difficulty of adopting this view for school purposes is precisely the difficulty which faces the new school of geography teachers, namely, that the rationalising motive, the desire to build up a system for its own sake, does not develop in the English schoolboy much before his sixteenth or seventeenth year. Dr. Nunn has therefore based his method on the utilitarian motive, and aims at every stage to exhibit the value of the results for application. At the same time he seeks to comply with the schoolmaster's demand that the subject shall have "training value." Thus algebra for school purposes becomes an instrument the capabilities of which are throughout explored, and so extended, a kind of linguistic for the expression of thought operations. A large audience followed with keen interest Dr. Nunn's application of the theory in such crucial instances as the factorisation of a^2-b^2, and the explanation of the product of two negatives. The processes under his hand revealed the behaviour of realities, and no longer, as of old, came out of the void.

As an illustration of research upon mental processes Dr. Spearman gave an account of an inquiry into individual variations of memory among some 400 subjects. His results showed that the correlation coefficient between different ways of memorising was always positive, or, in other words, that the powers of memory showed some tendency to correspond, however the material upon which they were exercised might vary, while the more like two performances were the greater was the degree of correspondence. The common view that people of quick memory forget more rapidly than those to whom memorising is a slow process was shown to be erroneous, the correlation coefficient between the two remaining the same after a lapse of time. It was also shown that the difference between the two types could be largely traced to the method of recall, the quick memory being predominantly auditory and motor, the retentive memory visual and ideal. Finally, a high correlation was established between memory and teachers' estimates of general intelligence, in spite of the fact that the data upon which the latter were based were often obscure and variable.

The remainder of the sitting was occupied by a series of papers and discussions on the measurement of intelligence, in which accounts were given of practically all the researches on this subject hitherto conducted in this country. Dr. Otto Lipmann discussed the methods of Binet and Simon (*Année Psychologique*, 1908, xiv., pp. 1–94) and of Bobertag (*Zeitschrift für angewandte Psychologie*, iv.). His paper has been printed in full in *The School World* (October), so that here it will suffice to say that in his opinion their methods do not promise any certain test of a high degree of intelligence. We associate intelligence of this character with depth and power of self-criticism; but these things must be neglected in experimental tests, for results which would demonstrate the absence of these may be due to bodily condition or temporary inattention. On the other hand, the tests of Binet and Simon will establish with certainty whether a child is of sufficiently normal intelligence to be equal to the public-school course. The importance of this achievement will be seen when it is remembered that under English law a school medical officer may at any moment find it necessary to satisfy a bench of magistrates that a particular child ought to be sent to a special school for mentally defective children.

Mr. Cyril Burt described a series of experiments performed with a group of elementary-school children at Oxford, the result of which was to cast doubt upon the view that there is an intimate correspondence between power of sensory discrimination and general intelligence. A series of experiments with girls of secondary-school age at Liverpool tended to show that, by comparison with simple sensory and motor tests, tasks involving higher and more complex processes are less liable to be vitiated by absence of special training in the experimenter, and also have a more intimate relation with intelligence. Mr. William Brown discussed the mathematical technique of the evaluation of the results of intelligence tests, and maintained that the method of multiple correlation should always be employed.

Mr. J. G. Gray asserted the value of perseveration as an index of the quality of intelligence, explaining perseveration as dependent upon an elemental brain property which determines the persistence of mental impressions. He described a modification of Wiersma's colour disc devised by himself in order that the luminosity of the two colours the fusion of which at a certain rotation speed gives the index of perseveration might be regulated by the experimenter.

Mr. H. S. Lawson described a series of tests, based upon Binet's, to which the candidates for scholarships at a Midland secondary school were submitted. The order thus established was correlated with the official scholarship order in two successive years, the coefficients being 0·217 and 0·485. The tests had also been used to check the official order of merit obtained from a term's marks

in certain forms. In every case the correlation coefficient was high.

Miss Katharine L. Johnson read an interesting paper on the results of the application of Binet's tests to 200 schoolgirls in Sheffield. In her experience one of the chief difficulties was the personal equation of the experimenter. It is impossible to maintain the same tone and expression throughout, and children are very susceptible to suggestion. It is also difficult, sometimes, to estimate the results. She had found cases in which girls failed in the tests for their own age or for the age preceding, and yet satisfied the tests for a superior age.

Dr. E. Neumann's paper was summarised by Dr. Lucy Hoesch Ernst. He cast a doubt upon the possibility of determining a normal standard of intelligence for each year of school life which would be of general validity because of the difficulty of excluding acquired knowledge.

Dr. C. S. Myers entered a caveat against the collection of masses of psychological data by untrained observers. He was of opinion that the personal equation of the observer could not be got rid of, and that therefore comparison of results was only possible within very narrow limits. Racial differences in correlation are bound to vitiate the results of the examination of a sample of a heterogeneous people. But the main source of error lies in the neglect of the introspective element. A test of mental fatigue may in different subjects involve the play of such complicating factors as boredom, duty, ambition. It is only by individual introspection that we can determine exactly what factors an experiment involves. The result derived from the wholesale collections made by untrained observers can be nothing but a blur in the psychological aspect, though a sort of standard of productiveness may be obtained from them whereby we can measure the individual.

Dr. W. H. R. Rivers summed up the long discussion. In his opinion the work done was well worth doing, and marked a great advance regarded from the point of view of the scientific psychologist. But an enormous amount would still have to be done before the results could be applied practically in education. The work, so far, had been work with mass results, whereas the teacher wanted to test the individual. In spite of what had been said of the need for training in the investigators, it was all to the good that teachers were beginning to take up psychopedagogy.

On the third day of the meeting there was a series of papers on practical work in schools. The Board of Education's recent Memorandum on Manual Instruction came in for a good deal of praise. Sir Philip Magnus, as an old fighter in the cause of handicraft, urged that we should not fold our hands until the Board's four principles were everywhere observed, that handwork should be taught to all intending teachers, and that there should be a continuous course of it in every school taken by the ordinary teachers of the school. The president of the association spoke of the value of handwork as fostering self-help and initiative. Mr. J. G. Legge suggested the establishment of a type of school for boys from twelve to fourteen in which half the curriculum should be given to constructive work, and half the day should be spent in the workshop. Such a school would lead directly to technical training as the next stage in the education of the pupils. Mr. James Tipping described the vacation courses of the Educational Handwork Association, in which many teachers have acquired the manipulative skill, and at the same time the pedagogical knowledge, needed by teachers of handicraft; and Dr. G. H. Woollatt outlined a hundred-hour course for teachers in the making of scientific apparatus. Miss Cleghorn, in closing the discussion, warned the audience that enthusiasm in the teacher was a *sine qua non*, and hinted, at the same time, that it was difficult to be enthusiastic over the introduction of more subjects into the too short school life of the ordinary child.

Mr. Blair's paper on the relations of science with commerce and industry has already appeared in NATURE (September 15). The subject is usually treated on both sides in a spirit of vague vituperation which profits nothing. Mr. Blair's skilful marshalling of a mass of evidence from university graduates, professors, business men, and manufacturers all the world over will be of service to combatants on both sides who desire composition and not strife. In the short discussion which followed Principal E. H. Griffiths advocated bringing home to the lay mind the value of such work as Faraday's and Lister's. We should then hear less of the disinclination to believe in the application of science to business life and industry. He also advised scientific men to leave the language of the laboratory behind them when they came into the market-place, recalling Sir George Reid's words in the tests of intelligence discussion:—"It will be a grand thing when our men of science really do know everything they talk about, because when they do they will be able to tell us what it all means in plain English."

Dr. Beilby thought that things were improving; the great need was more cooperation between the two parties. The difficulty was to get the scientific man and the men of the markets together. In joint committees of professors and business men each side educated the other.

Sir William White also thought that there was no reason for alarm. We did not compare so badly with other countries. True, our rivals were better organised, but then organisation may paralyse effort. The young trained graduate of the technical college would not straightway apply his knowledge in industry; he had not the knowledge of practical business conditions. Such men should go through post-graduate courses, if possible, in works' laboratories. We must be content to train many mediocrities in order to catch the man of brilliant ability, and fortunately it takes all sorts to make the worlds of commerce and of industry.

Dr. Stead said that in the steel industry the value of research was recognised. The manufacturers had reached the point of wanting a little too much from research, and in too short a time.

Dr. H. E. Armstrong also advocated a two or three years' course in a work's laboratory for the technical-school graduate, and quoted the example of Sir Lothian Bell. Our organisation was at fault; when that defect was remedied the nation would soon regain its former commanding position in manufacture and commerce.

On the last day of the meeting an interesting series of papers was read on outdoor studies in schools of normal type. Prof. Mark R. Wright described the summer camp of the Durham Training College, Mr. G. G. Lewis showed what could be done by means of school journeys for London elementary-school children, and Mr. J. E. Feasey explained how much the interest and practicability of ordinary school work could be heightened by adapting it to the conditions of the open air.

In the afternoon there was a lively, though inconclusive, debate on voice production, in which Dr. Gray, Prof. Wesley Mills, Dr. Hulbert, Mr. W. H. Griffiths, Miss Ormay, Dr. Chichele Nourse, Prof. Silvanus Thompson, and others took part.

THE PRODUCTION AND USE OF ELECTRIC POWER.[1]

THERE are few subjects more important to the people of this country than the question of the rapid and ever-growing rate at which we are using up our coal supplies. Many writers have dealt with this subject, and have suggested various remedies.

It may be said that the rate at which we can use coal is a measure of our industrial activity and prosperity. This would be true, perhaps, if we were using our coal without waste, or at least with reasonable economy, but it is certainly not true of what we are at present doing.

Taking all the uses for coal into consideration, I believe that we are getting back an amount represented by useful work of one kind or another of much less than 10 per cent. of the energy in the coal. We can never, of course, hope to get anything like the full value of the energy in the coal, but, on the other hand, throwing away more than 90 per cent. of the value of our coal in the process of conversion is of the greatest possible concern to the country. Moreover, there is a further waste involved in our present methods of using coal which is only second in importance to the one I have spoken of. We now dissipate nearly the whole of the valuable by-products con-

1 From the Inaugural Address delivered at the Institution of Electrical Engineers on November 10 by Mr. S. Z. de Ferranti.

tained in the coal, consisting principally of fixed nitrogen.

It is in the process of transformation of coal into work in the form of heat and power that the great loss occurs, as this is always a most difficult process, and requires the highest scientific and practical skill to carry out with even very moderate economy.

It has been proposed, with the view of accomplishing the above ends, to treat the coal at central stations and turn it into gas and distribute the energy in this form, but this process only goes a small way towards a solution of the problem, as under it combustion—which is such a difficult problem—would be taking place at numerous points over the whole country, all tending to inefficiency, and the conversion of the gas into power is by no means easy, involving running machinery of the reciprocating class, requiring special and skilled attendance.

It appears that with a problem such as we are discussing it is fundamental that the energy in the coal should be converted at as few centres as possible into a form in which it is most generally applicable to all purposes without exception, and in which it is most easily applied to all our wants, and is, at the same time, in a form in which it is most difficult to waste or use improperly.

We are therefore forced to the conclusion that the only complete and final solution of the question is to be obtained by the conversion of the whole of the coal which we use for heat and power into electricity, and the recovery of its by-products at a comparatively small number of great electricity-producing stations. All our wants in the way of light, power, heat, and chemical action would then be met by a supply of electricity distributed all over the country.

It must, however, be remembered that the distribution of energy in the form of electricity instead of coal can only be effectively carried out when it can be done in such a way that it is available for all the purposes for which coal is now used, and this can only be the case when the conversion is effected at such an efficiency as will cause the electric energy delivered to represent a high percentage of the energy in the coal. Failing this, no scheme for conversion at the pit's mouth and delivery of energy in the form of electricity is sound. There is also another controlling factor which must be satisfied in order to make this scheme possible. Both the conversion of the coal into electricity and the distribution of the current must be effected at a low capital cost, so as not to overburden the undertaking with capital charges.

Considering the various processes of conversion which are now available, or may be invented, and their possible and probable efficiency, we first come to electric generators driven by reciprocating steam engines. Their economy, expressed in the form of energy in the coal to electric energy, may be taken as a maximum of 10 to 12 per cent. This is, of course, far too low an efficiency to make any scheme such as I have already indicated possible, besides which the capital expenditure and the complication involved are far too great and the size of the units too small to be thought of for the purpose in view.

We next come to large steam turbines such as have been constructed up to the present, and see that their maximum efficiency may be put down at about 17 to 18 per cent.

Next in the list, in order of economy, comes the big gas engine fed from gas producers, with an efficiency of coal energy to electric energy of possibly 25 per cent.

In the future we have to look towards two other means of conversion—the gas-turbine-driven electric generator and the production of electricity in some more direct way from the coal; but these two means of conversion, although being capable of giving the most efficient results, are so much in the distance that they are quite beyond our present consideration.

After very careful thought on the subject I have come to the conclusion that, in order to supply electricity for all purposes, it would be necessary, amongst other things, to have a conversion efficiency of not less than 25 per cent.

For the purpose of looking into this question I have taken the figures of production and consumption given in the report of the Royal Commission on Coal, which clearly summarises the position as it stood a few years ago, and as the increase taking place is fairly regular these figures have been taken throughout. According to this report 167 million tons of coal were being used in the country in 1903. Of this amount 2 million tons went to coasting steamers and 15 million tons were used by the gas companies. In order to simplify matters and make the figures clear, I have left out of consideration the coal used on these two items, and taken the balance—viz. 150 million tons—as the annual coal consumption of the country. If now, instead of using this coal for doing work, as at present, we were to convert it into electricity, we should use, instead of 150 million tons, 60 million tons of coal a year. This coal, turned into electricity, would produce 131,400 million Board of Trade units, and the electricity so produced would, after allowing for losses of transmission and conversion into work of different kinds, be sufficient to supply the whole of our requirements now being satisfied by the use of the 150 million tons of coal which we now burn.

Summarising the whole position, it may safely be said that, wherever coal, gas, or power are now used, everything for which they are used will be better done when electricity is the medium of application.

Hardly less in importance in the all-electric scheme is the question of the by-products which become available by the proper use of our coal. These consist principally of fixed nitrogen, together with tar and oils.

Fixed nitrogen in the forms of sulphate of ammonia, nitrate of soda, and nitrate of lime are most valuable fertilisers, and enable land continually to produce the same crops with a greatly increased yield per acre. Much has been done in finding out how best to utilise these artificial fertilisers, but no doubt a great deal more will be done in this direction, and fertilisers will be prepared, with fixed nitrogen as their principal constituent, which best suit the particular soils and crops that it is desired to deal with.

According to last year's Board of Trade returns, we now grow about 23 per cent. of the total wheat that we use and import 77 per cent. Of the barley used we grow 59 per cent. and import 41 per cent., and of the oats used 78 per cent. is home grown and 22 per cent. imported. Last year we devoted $7\frac{3}{4}$ million acres to the cultivation of these crops.

Much is being done to improve the yield of corn crops, and it is probable that with scientific treatment in the production of the seed, in the sterilisation of the ground, and in the application of fertiliser, we may look at no distant date to an increased yield of 50 per cent. in these crops upon what is now being produced per acre. The most vital feature, however, in bringing this about, once we have acquired sufficient knowledge, is an ample supply of fixed nitrogen to use as fertiliser, and it is when considered from this point of view that a scheme which supplies this from our coal as the result of saving present waste is most important.

With the increased yields which we have mentioned we could produce corn crops sufficient to supply the whole of our requirements upon 11 million acres. This would represent $23\frac{1}{2}$ per cent. of our present cultivated area, and would only be an addition of $3\frac{1}{4}$ million acres to the land now used for the purpose of growing these same crops. The value of these additional crops would be about 58 millions sterling, based upon the prices which we paid last year, and to this would have to be added the value of the straw and the other wheat by-products, which would go a long way towards providing the food for growing the additional meat which we require to supply our demand at home.

In order to fertilise the land we should have available, under the all-electric scheme, 3 million tons, or its nitrogen equivalent, of sulphate of ammonia. This, if used over the whole of the $46\frac{3}{4}$ million acres now under cultivation, would give 143 lb. per acre; but, of course, the fertiliser would be distributed according to the nature of the land and the crops being grown. It is probable that in these circumstances the increased yield of the land now cultivated would not only give us all the grain that we should require for food, but also all the foodstuffs, partly as by-product from the grain and partly grown, that would be required for raising the cattle, sheep, and other animals necessary to supply the whole of our wants.

It is now beginning to be understood that intensive farming of the land also involves intensive cattle raising,

and that it is very advantageous greatly to reduce the amount of grass land and instead to grow crops intensively cultivated, as in this way a given amount of land can be made to produce a much larger yield.

Sulphate of ammonia is a particularly good fertiliser for the purpose of growing sugar beet, and here again it is probable that the availability of large quantities of this fertiliser at a very much lower price than at present prevails would enable us to produce the whole of our sugar at home, especially as the by-product, obtained in the form of crushings from the beet, is a very valuable food for cattle raising, and also as the crop is a very suitable one for growing alternately with wheat.

If it was found that a larger amount of fertiliser than the 3 million tons of sulphate of ammonia, which would be the principal by-product from 60 million tons of coal turned into electricity, could be advantageously used, this would be very economically produced from the electrical station by the oxidation of atmospheric nitrogen, giving a valuable fertiliser in the form of nitrate of lime. This could be made intermittently by means of current filling up the load curve, and would not necessitate the expenditure of any more money on plant for generation or transmission of the current. It would, however, require the burning of additional coal, and this in itself would add to the sulphate of ammonia available.

It is assumed by many people that the climate of this country is largely unsuitable for the purpose of growing food, and for this reason it is thought that we can never grow the food which we require. This is largely a misconception, as crops both large in quantity and of good quality can be produced in this country. Nevertheless, it would be a desirable thing if, instead of the dark weather that we now often experience owing to cloud obstruction, we could have continuous sunshine at certain times of the year. The amount of sunshine would, no doubt, be largely increased by the abolition of all smoke in the air, as not only does the smoke itself obscure the sun, but also it seems to have the effect of assisting the formation of cloud, which greatly diminishes the light and heat which we receive.

At present it is considered quite right and reasonable to canalise rivers and make great works for adding to the fertility of countries by means of irrigation, but I believe that in the future the time will come when it will be thought no more wonderful largely to control our weather than it is now thought wonderful to control the water after it has fallen on the land. I think that it will be possible to acquire knowledge which will enable us largely to control by electrical means the sunshine which reaches us, and, in a climate which usually has ample moisture in the atmosphere, to produce rainfall when and where we require it.

It seems to me that it may be possible, when we know a great deal more about electricity than we do to-day, to set up an electrical defence along our coasts by which we could cause the moisture in the clouds to fall in the form of rain, and so prevent these clouds drifting over the country between ourselves and the sun which they now blot out. It also seems to me that it will be possible, when more water on the country is required, to cause the falling of rain from the clouds passing over the highest part of the country, and so produce an abundance of water which, properly used, would greatly add to the fertility of the country.

Of course, it may seem that these are only mad visions of the future, but I think we can hardly consider these results more improbable than anyone would have considered wireless telegraphy or flight in heavier-than-air machines fifty years ago. My excuse for mentioning these matters here is that they might constitute another great use of electricity, and their useful consummation would certainly be facilitated by an abundant supply of electrical energy.

At present, although the using of our coal may mean commercial activity, it certainly means the desolation of the country in parts where it is largely used. Instead of this harm being done to the country by our coal, we should fertilise the lands by its means, and might even, as I have indicated, use it in the future to increase our sunshine.

Of course there are many things which at present stand in the way of realising such a scheme as I have outlined. There are many technical details which nothing but an immense amount of work can solve satisfactorily. There are also political and legislative difficulties standing in the way, but these, when the time arrived, would have to be got rid of rather than allow them to handicap the advance of the country. The more, however, that I have considered these ideas in detail, the more certain am I of the fundamental soundness underlying them, and that it is only a matter of time before such a scheme is carried out in its entirety.

What interests us most, perhaps, is the question of how long it is likely to be before the all-electric idea becomes possible. At present there is so much required to be done to make it workable in all its details that it seems as though its realisation would be long deferred. It must, however, be remembered that knowledge is continually being acquired which brings us nearer to its realisation, and that things engineering, and especially in electrical engineering, now move very rapidly. It may therefore come to pass that the all-electric idea, with its far-reaching changes and great benefits, will become an accomplished fact in the near future.

MATAVANU: A NEW VOLCANO IN SAVAII (GERMAN SAMOA).[1]

THOUGH not the seat of government, Savaii is the largest of the Samoan Islands in the Central Pacific Ocean. It has a backbone of volcanic mountains, some of which rise to a height of more than 4000 feet; most of them are extinct or dormant, but there have been several small eruptions within the last 200 years, and one as lately as 1902.

The volcano of Matavanu was formed in 1905 to the north of the main ridge, and near the centre of the island. The early part of the eruption was characterised by explosions, and the ejecta were mainly solid, but later on

Photo.] [*T. Anderson.*

FIG. 1.—Steam Clouds from Lava falling into the Sea.

[1] Abstract of a Discourse delivered at the Royal Institution on Friday, April 29, by Dr. Tempest Anderson.

an enormous quantity of very fluid basic lava has been discharged. This has flowed by a sinuous course of about ten miles into the sea, devastated some of the most fertile land in the island, and covered it up with lava fields probably not less than twenty square miles in area.

The crater contains a lake, or rather river, of molten lava so fluid that it rises in incandescent fountains, beats in waves on the walls, and rushes with great velocity down into a gulf or tunnel at one end of the crater. The lava, still liquid, runs in a passage, or perhaps system of passages, under the surface of the lava field, its course being traceable by a line of large fumaroles until, still in a fluid condition, it reaches the sea, into which it flows with energetic explosions and the discharge of large volumes of steam, black sand, and fragments of lava. Where the action is less violent a structure resembling that of some varieties of pillow lava is produced.

FIG. 2.—Pit Crater in Lava Field, on the line of the Lava Tunnel to the Sea.

Photo.] [*T. Anderson.*
FIG. 3.—Lava in Lagoon corded above high water-mark: Pillow Lava below.

The term pillow lava, originally applied to the results of a peculiar form of spheroidal weathering, is now extended to various smooth-surfaced lobular masses, which have been considered by Teall, Cole, and Gregory to be formed by lava flowing into water. This view has been combated by others; but Dr. Anderson watched the process actually going on, and photographed the results.

The formation of ordinary "corded lava" or "pahoehoe" takes place by a local quiet outflow of lava which forms a pool or lobe. The surface, being slowly cooled by the air, forms a more or less tenacious, treacly scum, which is pushed forward by the liquid mass underneath, and is puckered up into a cord or festoon. While this is taking place the new surface is becoming treacly, and in its turn is pushed forward into another fold, and so on until the whole surface is solidified, often with a very regular pattern.

Dr. Anderson said he had seen this taking place on Vesuvius, and had watched the same process going on at the sea-level at Matavanu. The surface of the lobes, however, being in that case exposed to the waves, was rapidly chilled, and solidified before it had time to be pushed forward to form "corded structure." A photograph of a recent flow into the lagoon showed corded structure above high-water mark, while lower down there was every transition into typical pillow lava.

The surface of the lava field shows several large pits along the line of the lava-conduit to the sea, out of which steam and vapours escape. They are larger than ordinary fumaroles, and appear to be formed by the remelting and falling in of the crust owing to the heat of the lava which flows beneath. The sections exposed in their walls show the lava field to consist of numerous very thin beds, partly surface flows, but probably in many cases intrusive sheets. This structure is very similar to that of the "pit craters" in Hawaii, the mode of formation of which is still unsettled. Possibly they may have been formed in the same way.

Other interesting points noticed were the formation of moulds by lava flowing round living tree trunks. The trees were, of course, killed, and when they decayed hollows were left corresponding to their former shapes. Occasionally, after the lava had solidified round a tree the remainder had flowed away; when the tree decayed a sort of hollow pillar was thus left, in which smaller plants sometimes grew.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The Huxley lecture will be delivered on November 23 by Prof. Percy Gardner, professor of classical archæology in the University of Oxford. The subject of the address is "Rationalism and Science in Relation to Social Movements."

BRISTOL.—In connection with the faculty of engineering provided and maintained in the Merchant Venturers' Technical College, a course of five monthly lectures on "Aviation" has been arranged. The selected lecturers are Prof. W. Morgan, Mr. A. R. Low, Mr. E. S. Bruce, Mr. L. Blin Desbleds, and Mr. Joseph Clarkson.

A new wing erected for the chemical and physiological

departments of the University, at a cost of 50,000*l.*, was opened by Lord Winterstoke on November 15.

CAMBRIDGE.—On Saturday last, November 12, a large assembly of physicists from all parts of Great Britain, and many members of the University, came together in the Cavendish Laboratory on the occasion of the presentation to Sir J. J. Thomson of a volume entitled "A History of the Cavendish Laboratory, 1871–1910." The volume had been prepared to commemorate the completion of the twenty-fifth year of Sir Joseph Thomson's tenure of the Cavendish professorship of experimental physics. The presentation was made by Dr. R. T. Glazebrook, director of the National Physical Laboratory, who was for many years associated with the late and present Cavendish professors. The volume begins by recording the fact that perhaps no post in the world has held three men of such supreme and varied genius as James Clerk-Maxwell, Lord Rayleigh, and Joseph John Thomson. It contains a remarkable record of work, and concludes with a list of the memoirs which have been published in connection with the Cavendish Laboratory, which extends over forty-two pages, and a list of some two hundred men of science who have researched in the laboratory. We hope to publish a review of the volume in an early issue.

Mr. A. Hutchinson, of Pembroke College, has been appointed chairman of the examiners for the Natural Sciences Tripos, 1911.

Mr. J. S. Edkins, of Gonville and Caius College, has been approved by the general board of studies for the degree of Doctor in Science.

LIVERPOOL.—On November 14 the honorary degree of LL.D. was conferred by the University upon Sir Archibald Geikie, K.C.B., president of the Royal Society.

OXFORD.—The Herbert Spencer lecture on "Evolution, Darwinian and Spencerian," will be delivered by Prof. R. Meldola, F.R.S., on December 8 at 2.15 p.m.

IT is announced in *Science* that the State legislature of Arkansas has voted 70,000*l.* for the erection of four agricultural schools, and 100,000*l.* additional has been raised by the cities.

WE learn from the *Revue Scientifique* that the buildings of the medical faculty of the University of Toulouse were partially destroyed by fire on October 27. The library of more than 60,000 volumes was burnt entirely, and also the physiological lecture theatre and other rooms.

THE Department of Agriculture and Technical Instruction for Ireland has issued a programme of the Irish Training School of Domestic Economy for the session 1911–2. The school is situated at St. Kevin's Park, Kilmacud, Stillorgan, co. Dublin. The premises stand in grounds of about three acres, and the house provides ample accommodation for the staff and students, in addition to class and recreation rooms. A large fruit and vegetable garden is attached to the house. At the close of each school year, the Department, on consideration of the results of the examination held at the close of the course of household management, and the reports of their inspectors and of the teaching staff, selects for training as teachers of domestic economy a limited number of students who have shown themselves most capable of taking full advantage of the course of training provided. The course of training extends over at least two whole sessions, and involves a complete course of domestic economy suitable for teachers of this subject. It includes the principles of practical elementary science involved in domestic work; cookery; laundry; dressmaking and home sewing; housewifery (including household routine and the keeping of accounts); and practice in the teaching of these subjects. Practical instruction in home hygiene and sick nursing is afforded, and instruction is given in the theory and practice of education.

IN a letter to the *Yorkshire Observer* of November 11 Prof. R. Meldola, F.R.S., urges the need for the provision in this country of a larger number of scholarships for research. "Why, in the name of all that is sacred to the industrial welfare of this country, are not some of the vast sums now devoted to educational purposes available for research scholarships in existing institutions?" asks Prof. Meldola. Later in his letter he says, everything is ripe for the movement. There are competent teaching staffs; there is always a supply of promising students; there are funds from county councils and from public and private endowments; and there is the Treasury behind the Board of Education. There are scholarships given for all kinds of purposes other than for the continuation of the education of the most promising technical students in the institutions in which they received their preliminary training so as to enable them to add one or two years in learning to wield that most powerful of all educational and industrial weapons—the faculty of originality. And to crown all, the manufacturers and employers in this country are now beginning to take a more enlightened view of the situation, and are prepared to employ such men—when they can get them. It seems preposterous that year after year we should see ability, talent, and even genius slipping through our hands for want of means, when educators on one hand and employers on the other are both ready to play their part in promoting the industrial development of the country. We want, he concludes, a system of technical research scholarships which will be looked upon as a distinction to gain, for none but the most competent would be allowed to hold them. We want through such means to strengthen and encourage the work of the teachers by filling their laboratories with research students, and we want to advance British industry by handing over to the manufacturers the picked material from our educational institutions. As a leading article in our contemporary points out, there is no reason why the success which has attended the efforts of Prof. Arthur G. Green and his colleagues at Leeds University in encouraging among the advanced students of applied chemistry research in connection with the art of dyeing should not follow similar efforts in other centres.

IN Dr. Muir's report on education in Cape Colony in 1909, which has come to hand, he shows that in 1891 there were five colleges in the colony where students could pursue courses of study for a university degree, viz. the South African College, Cape Town, the Diocesan College, Rondebosch, the Victoria College, Stellenbosch, St. Andrew's College, Grahamstown, and the Gill College, Somerset East. A large proportion of the teaching power, however, in all these institutions was given to what was, properly speaking, school work, namely, the preparation of large classes for matriculation. Mathematics and chemistry, too, were the only sciences for the teaching of which provision was made. From its inauguration the policy pursued by the Education Department kept three aims in view. The first was the removal of the matriculation classes from the colleges, so that professors might have more time for advanced work, while the pupils of the junior classes might in the public schools be under a discipline more suitable to their years. The second was the institution of new professorships, more especially in the sciences, until then unrepresented; and the third was a reduction in the number of colleges—a number which seemed at the time excessive for the total number of students. Victoria College, Stellenbosch, was the first that agreed to part with its matriculation classes, the junior class in 1896 and the senior in 1899. In the latter year the South African College was induced to follow the example. At present practically all the colleges have ceased to retain matriculation classes. Since 1891 there have been instituted in connection with the colleges professorships of physics, applied mathematics, geology, botany, and zoology. In addition to the then existing courses in arts, law, and survey, there have been opened new courses in arts as well as professional courses in mining, civil and electrical engineering, medicine (preliminary), and forestry. On the literature side there has also been development, professorships in history and lectureships in Hebrew having been established in connection with the larger colleges. The movement towards greater concentration of effort in fewer colleges has been brought to a successful issue in the eastern province. The Gill College, Somerset East, has been closed, St. Andrew's College has restricted itself to school work, and in Grahamstown, by the happy union of all interests, the Rhodes University College has taken their places and become the centre of higher education for the eastern province.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 10.—Sir Archibald Geikie, K.C.B., president, in the chair.—Sir George **Darwin**: (1) The tidal observations of the British Antarctic Expedition, 1907; (2) a mistake in the instructions for a certain apparatus in tidal reductions.—F. **Soddy** and A. J. **Berry**: Conduction of heat through rarefied gases.—II. The thermal conductivities of argon, helium, and hydrogen at very low pressure have been examined in greater detail with new and improved apparatus. The hypothesis provisionally put forward (Roy. Soc. Proc., A, vol. lxxxiii., 1910, p. 254), that the interchange of energy on impact is imperfect in the lighter gases, has been tested and found not to account for the smallness of the ratio (K/Q) of the found to the calculated conductivities. The conductivity of hydrogen using a palladium hot wire is the same as that with a platinum wire. Change of temperature of the hot surface, that of the cold surface remaining constant at room temperature, does not exert so much influence on the value of K as was anticipated. The value of K/Q tended to diminish as the difference of temperature increased, especially at high temperatures. At low temperatures, attained by immersing the apparatus in liquid air and in solid carbon dioxide and ether, the ratio K/Q is *diminished*, whereas on the hypothesis of imperfect interchange of energy an increase was expected. Jacketing the apparatus with vapours up to 264° caused an increase in the value of K/Q. It appears that, most probably, increase in the difference of temperature between the surfaces tends to decrease the value of K/Q, whereas increase in the temperature of both surfaces increases it. Argon under some of the new conditions tried conforms to the theory hardly better than the other gases, and the agreement found previously was probably fortuitous. The general conclusion is that the conductivity at low pressures varies less with the nature of the gas and with the temperature of the experiment than is to be expected from kinetic considerations. The extreme values found for the conductivities of the three gases over a range of about 450° lay between 0·8 and 3·4, whereas the calculated values lie between 0·95 and 16·2 ($\times 10^{-5}$ calorie, per sq. cm. of hot surface, per 1° difference of temperature, per 0·01 mm. pressure of gas).—W. H. **Hatfield**: The chemical physics involved in the precipitation of free carbon from the alloys of the iron-carbon system. The intention of the author is to examine the conditions under which free carbon is produced in iron and steel. Whereas it has been an open question as to whether or not free carbon could be produced direct from the solid solution, the paper is intended to prove the truth of the theory that free carbon can only be produced by the dissociation of the free carbide. It is hoped to demonstrate that this theory holds good through the whole range of the alloys in which free carbon, whether as graphite or annealing carbon, is found. After the presentation of evidence in support of this view of the production of graphite in and near the freezing range, experiments, performed to determine the chemical physics underlying the liberation of annealing carbon in white cast iron, are described. By the electrolytic method of analysis the cementite carbide was obtained from such irons of varying composition, and it is shown how, by varying the percentage of silicon, manganese, or sulphur in the iron, the composition of the cementite is modied and its degree of stability at varying temperatures determined. It is also shown that the size and structure of the precipitated annealing carbon is largely due to the size and structure of the original cementite. Experiments performed to produce annealing carbon in blister steel during the cementation process are then described, after which an explanation of the phenomena of "black" steel is discussed; it is shown that the free carbon found in such steels may present one of two formations, each produced under different conditions. The author further endeavours to demonstrate that whilst the free cementite carbide is dissociated at high temperatures through the whole range of the alloys, the carbide remaining in solid solution does not dissociate until the resolution of the solid solution into the carbide and iron of the pearlite, at the carbon change point.—Dr. F. **Horton**: A spectroscopic investigation of the nature of the carriers of positive electricity from heated aluminium phosphate. The emission of positive ions from substances heated in a vacuum has been investigated by several experimenters, and it has been found that the ratio of the charge to the mass of the ions is the same for all the substances so far experimented on. Assuming that the charge is equal to that carried by the hydrogen ion in electrolysis, the mass of the carriers of positive electricity from heated substances must be about twenty-six times that of the hydrogen atom. The object of this research was to obtain the spectrum of these ions. Aluminium phosphate was chosen for investigation, because of the very large positive ionisation produced on heating this substance. A calculation showed that, with the apparatus used, it might be expected to collect a sufficient quantity of the carriers to obtain their spectrum in a small vacuum tube. The vessel used to collect the carriers was cooled in liquid air during the passage of the thermionic current from a strip of platinum covered with aluminium phosphate to a surrounding platinum cylinder. The material collected was then allowed to vaporise, and its spectrum was obtained by rendering it luminous with an electrodeless ring discharge. The spectrum of carbon monoxide was always obtained, although precautions had been taken to exclude this gas, or materials which might give rise to it, from the apparatus. It is concluded, therefore, that the positive ions consist of carbon monoxide, the molecular weight of which agrees fairly well with that required by the results of the e/m determinations. It is considered improbable that this gas is evolved on heating every substance which has been experimented on in the determinations of the specific charge, but from the nature of the apparatus used it must always have been present during these determinations. In the paper reasons are given for believing that molecules of carbon monoxide readily act as carriers of positive electricity, and this gas probably diffuses into the hot metal or other substance and is evolved in an ionised state.—N. **Bohr**: The determination of the tension of a recently formed water-surface. Arguments in further support of the author's previous conclusion, that the surface tension does not change sensibly with the time that has elapsed since the surface was formed.—Lord **Rayleigh**: Aërial plane waves of finite amplitude.—J. J. **Manley**: Observations on the anomalous behaviour of delicate balances, and an account of devices for increasing accuracy in weighings.—Prof. F. W. **Dyson**: The improbability of a random distribution of the stars in space.—G. I. **Taylor**: The conditions necessary for discontinuous motion in gases.—The Hon. R. J. **Strutt**: (1) The radium content of basalt; (2) measurements of the rate at which helium is produced in thorianite and pitchblende, with a minimum estimate of their antiquity.

Royal Microscopical Society, October 19.—Mr. E. J. Spitta, vice-president, in the chair.—J. J. **Simpson**: Hicksonella, a new gorgonellid genus. The genus is established to include three species, all collected off South Africa. One species was described by Prof. Hickson in 1904 under the name of *Juncella spiralis*, but the author believes that a reference to the genus Juncella is impossible. The clearing up of the position of this puzzling specimen was facilitated by recent work of the author in his revision of the family of the Juncellids. In addition to *Hicksonella spiralis*, g.n., he describes *H. flagellata*, sp.n., and *H. capensis*, sp.n.—E. **Heron-Allen** and A. **Earland**: Some varietal forms of *Massilina secans*. After referring to several varietal forms that had been previously described, the authors related the finding of numerous specimens of three of these varieties in narrow observation tanks where some gatherings of Foraminifera, made off Selsey Bill, had been placed, and where they multiplied. The conclusion arrived at was that these variations were caused by the want of sufficient shell-making material, the carbonate of lime in the tanks having been used up, the sea water never having been renewed.—E. M. **Nelson**: A micrometric difficulty. The author referred to the difficulty of counting correctly the number of ruled lines, or diatomic striæ, in a given space. The trouble does not arise when the interspaces are relatively wide compared with the breadth of the lines, but it does so when the breadth of the interspaces approaches that of the lines. It is the black and white dot image that is

responsible for the trouble. When the focus is at a white-dot image the white lines must be counted, and *vice versâ* when the focus gives a black-dot image.—E. M. **Nelson**: The resolution of new detail in a *Coscinodiscus asteromphalus*. This paper has refeience to the resolution of further detail obtained by a new one-eighth objective by Zeiss, described in a previous communication. The new detail discovered is a fine sieve covering the so-called eye-spot in *C. asteromphalus*. As the size of the eye-spot is only 1/14,000th of an inch, it may be left to the imagination to estimate the size of the minute perforations forming the sieve.

Physical Society, October 28.—Prof. H. L. Callendar, F.R.S., president, in the chair.—Prof. Ernest **Wilson** and W. H. **Wilson**: A new method for producing high tension discharges. According to this method energy is taken from an alternating or continuous current source and stored in a magnetic field by an inductance; it is then permitted to surge into a condenser which forms with the inductance a *low* frequency oscillating circuit. When the energy is stored in the condenser the latter is mechanically bridged across the primary winding of a spark-coil, with which it forms a *high* frequency oscillatory circuit. The energy is then transmitted by the secondary winding of the spark-coil to the work circuit in the well-known manner. Briefly the following are some of the advantages gained:—(1) For X-ray work the inverse electromotive force at "make" is eliminated, thereby leading to increased life of the tube and to a more sharply defined radiograph. (2) Only a small magnetising current is required as the inductance has a nearly closed magnetic circuit. This gives rise to a very small C^2R loss and consequently higher efficiency. (3) On account of the long periodic time of the system between the periods of "break" and "short-circuit," the voltage across the contact of the interrupter at "break" does not rise to a high value, or rises so slowly that the contacts are well separated before it is developed. Hence immunity from sparking. (4) The method lends itself to few secondary turns and this keeps down the time constant. It also makes the coil lighter, cheaper, and more compact. (5) The method lends itself to low secondary resistance—a point of great importance in connection with radio-telegraphy. (6) The iron of the spark-coil can be kept small in amount, and special attention can be paid to its lamination and insulation, as it may have to be operated at frequencies of three or four thousand per second. (7) The elimination of sparking increases efficiency, and on board ship where coal gas is not conveniently obtainable this is an advantage. (8) The apparatus can be worked from direct-current or alternating-current systems at usual voltages, or from a portable battery of a few storage-cells. (9) The oscillatory current at "break" does not pass through the battery, and hence does not assist in its discharge. (10) The iron in the magnetic circuit of the external inductance has only to operate at low frequency, and hence it has not to be finely laminated. (11) When used on alternating-current systems, rectification, if desired, is easily effected by employing two short-circuiting brushes, one for each half-period, and allowing the second brush to short-circuit at the moment when the condenser is fully charged after allowing a second complete surge of the energy between the condenser and the inductance of the spark-coil. (12) The apparatus is light, efficient, and cheap, and is suitable for radio-telegraphy, X-ray, medical, and other work in which high-tension electricity is employed.—F. **Rogers**: The behaviour of steel under combined static stress and shock. Attention is directed to the importance of the time rate of increase of stress, ds/dt, in the behaviour of materials under stress. The exact determination of this rate must usually present much difficulty, but the indirect experimental method adopted consisted in submitting specimens of steel to shock whilst under static loading. The conclusion that steel is substantially less resistant to shock whilst it is under static stress appears to be definitely established. In some cases the effect of a large static stress was to diminish the resistance to shock by as much as 30 per cent. The correction for the work done upon the sample in applying the static load is relatively small. Thus the energy absorbed in breaking a sample of steel is greater when entirely applied as shock than when applied partly as shock and partly statically. This difference is considered to be due chiefly to the difference in the rate of increase of stress at the higher stresses in the two cases. The actual values of the highest stresses are not necessarily identical, but probably the higher the rate of increase of stress the higher is the greatest stress reached before rupture occurs, whilst, simultaneously, deformation is diminished, and the intimate nature of the breakdown suffers a corresponding variation. At the higher static loads employed some portions of the test-pieces were stressed beyond their elastic limits, and this may also help to account for a part of the diminution in resistance to shock.

Linnean Society, November 3.—Dr. D. H. Scott, F.R.S., president, in the chair.—Prof. W. A. **Hordman**: A comparison of the summer plankton on the west coast of Scotland with that in the Irish Sea. This paper is the result of a series of vertical plankton hauls taken with the "Nansen" closing tow-net (made of No. 20 silk) from the S.Y. *Ladybird* in July of the last four years, from various deep hauls (eighteen of them being from more than 100 fathoms) at various localities off the west coast of Scotland. A comparison of the collection shows (1) that there is a constancy year after year in the nature of the plankton at certain localities; and (2) that some of the localities, not very far apart, differ considerably from one another in the nature of their plankton at the same time of year (July). Some of these deep hauls consist markedly of zoo-plankton and others of phyto-plankton, and the latter show a close resemblance to the phyto-plankton hauls typical of the vernal maximum of diatoms in the Irish Sea. The complete disappearance of the phyto-plankton, which is such a marked feature in the summer (July and August) gatherings from the Irish Sea, does not seem to take place in some localities off the west coast of Scotland, and these phyto-plankton hauls are obtained, not in the deep fiord-like lochs, but in the open sea, *e.g.* off Ardnamurchan and off the islands of Rum and Canna in the Sea of the Hebrides.—J. C. F. **Fryer**: The structure and formation of Aldabra and neighbouring islands, with notes on their flora and fauna. Aldabra, situate 250 miles north-west of Cape Amber, is a large atoll with an almost complete land-rim, a large shallow lagoon, and a narrow fringing reef. The land-rim is composed of coral-limestone, which gives definite evidence that Aldabra was formed by elevation and once stood at more than 40 feet above sea-level, though rain-water denudation has reduced this to its present level of 15 feet. A deposit of guano, by combination with the limestone, has produced phosphatic rocks, interesting in that they prove that the lagoon was once non-existant, and has since been formed by erosion and denudation. The atoll is still being washed away, but the loss is in part compensated by the piling up of sand by wind and wave. The fauna and flora, though peculiar, have been largely derived from Madagascar, the flora being interesting in showing four distinct types of jungle. Assumption, Cosmoledo, Astove, are also islands and atolls of elevated coral-rock, and form an interesting series showing the loss of rock-land by erosion and its replacement by sand and clays. Giant land-tortoises still exist on Aldabra, and fossil remains were found on the three other islands visited; in this connection it is noteworthy that none of these islands has ever been connected with continental land.—H. B. **Bigelow**: The Siphonophora of the *Research* Biscayan plankton. The memoir forms the thirteenth report on Biscayan plankton collected on board H.M.S. *Research* in 1900. The collection consisted exclusively of Calycophoridæ, with the exception of a single fragment from another group. In his report of the Siphonophora of the *National*, Prof. Chun noted a similar absence of Physophoridæ during the North Atlantic summer, and suggested that these latter forms must be at considerable depths at that season, yet the numerous hauls of the *Research* with closing nets down to really great depths failed altogether to find them. On the other hand, it is only during summer that these Physophoridæ are found on the eastern coasts of North America, at a time when the cold current alongshore is at its warmest; and further, they were not uncommon in July and August during cruises of the *Research* in the Færöe Channel, in the cooler water of

more northern origin. All these facts seem to point to rather narrow limits, outside of which the Physophoridæ perhaps die down to a large extent seasonally, except for a few specimens which will reproduce when the temperature optimum is again reached. The second point of interest to which the author directs attention is that all the ten species captured—except one new genus and species—were also taken in the eastern Pacific expedition of the *Albatross* under the late Prof. Alexander Agassiz. The collection included one new species of Diphyes and one new genus, Nectopyramis, apparently a monophyid. On the question of vertical distribution, which was a main object of the cruise, the author has arrived at some conclusions of interest. The Calycophoridæ were comparatively rare at the surface, but most plentiful somewhere below 25 and above 100 fathoms. The only species taken sufficiently often to allow of discussion was *Diphyes appendiculata*. The diphyid or polygastric generation was uncommon at the surface, seemed to reach its plurimum about 75–100 fathoms, and below that was very seldom met with. The eudoxid or sexual generation, on the other hand, presented a plurimum at the surface, was taken less often down to 100 fathoms, and only once below that depth, namely, between 400 and 500 fathoms. Another form captured, *Chuniphyes multidentata*, has so far been recorded only from considerable depths; the captures by the *Research* fix it as low as between 2000–1000 fathoms, that is, between nearly $3\frac{1}{2}$ miles and 2 miles deep. The highest capture was in an open net hauled for an hour at 250 fathoms, and thence to the surface; but as it was taken in none of the ninety-five hauls above 250 fathoms, this is probably about its upper limit.

Mathematical Society, November 11.—Sir W. D. Niven, president, and subsequently Dr. H. F. Baker, newly elected president, in the chair.—Sir W. D. **Niven**: The relations of mathematics to experimental science (presidential address).—G. T. **Bennett**: The double-six of lines. Dr. W. H. **Young** and Mrs. **Young**: The existence of a differential coefficient.—Dr. W. H. **Young**: (1) Note on the property of being a differential coefficient; (2) conditions that a trigonometrical series may have the Fourier form.—F. **Tavani**: A class of integral functions which includes Riemann's Zeta-function.—T. W. **Chaundy**: The geometrical representation of non-real points in space of two and three dimensions.—J. E. **Littlewood**: The extension of Tauber's theorem.—F. B. **Pidduck**: The stability of rotating shafts.—J. E. **Campbell**: A class of orthogonal surfaces.—S. **Chapman**: Non-integral orders of summability of series and integrals.—Dr. A. R. **Forsyth**: Lineo-linear transformations, especially in two variables.—Dr. W. F. **Sheppard**: Notes on terminating hypergeometric series.—H. **Bateman**: The transformation of a particular type of electromagnetic field and its physical interpretation.—Dr. P. **Mahlo**: Über die Dimensionentypen des Herrn Fréchet im Gebiete der linearen Mengen.

MANCHESTER.

Literary and Philosophical Society, October 18.—Mr. F. Jones, president, in the chair.—Prof. G. Elliot **Smith**: The convolutions of the brain. The cortex is mapped out into a great number of territories, differing in structure and function, and varying in size in different mammals, not only because the sense-organs themselves vary in size and acuteness in different creatures, but also because in different orders and families a sense organ of a given size will have a varying cortical representation. Thus, if one were to take a dog and a baboon with eyes of the same size, the monkey will be found to possess a much larger cortical visual area than the dog. It is these differences which determine the varied plans of cortical folding and the resulting varieties in the patterns of the convolutions in different mammals. Folding occurs most often along the boundary line between two areas of different structure and function. The difference in the rate of expansion of two such areas is no doubt the reason for this type of fissure-formation—limiting sulci. In the second place a rapidly growing cortical territory, meeting with obstruction to its expansion on all sides, may become buckled in, and so a furrow develops along its axis (*i.e.*, within its area), instead of at its edges. This second class of furrow is much less frequent than the first class, and may be distinguished as the group of axial sulci. There is a third variety, which may be called the operculated sulcus, in which one lip projects over a submerged area. Sulci of this type are produced by the submerging of a specialised fringing territory surrounding a main sensory area. In the fourth place various mechanical factors come into operation to modify the form of furrows formed in one of these three ways, or even to produce new sulci. By the application of these principles it is possible to interpret the meaning and the mode of formation of most of the furrows which subdivide the higher types of cortex into numerous convolutions.

November 1.—Mr. Francis Jones, president, in the chair.—Dr. A. N. **Meldrum**: The development of the atomic theory. (ii) The various accounts of the origin of Dalton's theory. (iii) Newton's theory and its influence in the eighteenth century. There are numerous accounts of the genesis of Dalton's theory, one of which comes from W. C. Henry, another from Thomas Thomson, a third from J. A. Ransome, and two come direct from Dalton. All the narratives come from Dalton originally, for Henry, Thomson, and Ransome based theirs on conversations they had with him. The discrepancies between these various accounts can be explained only on the supposition that Dalton was deficient in historical instinct, and never appreciated the difference between describing the genesis of his theory and expounding the theory itself. The main conclusions of the second paper are (1) that Newton's contribution to the development of the atomic theory was made under the influence of Descartes; (2) that Newton exerted an influence in the eighteenth century on Bryan Higgins, and through him on William Higgins. The atomic theory advanced by Bryan Higgins (1776) and amplified by William Higgins (1789) can be understood only when regarded as springing from Newton's theory under the conditions of the time. Those conditions were:—(*a*) the knowledge due to Priestley of different kinds of gases, and (*b*) the new light which Lavoisier threw on chemical composition, consequent on Priestley's discovery of oxygen.

PARIS.

Academy of Sciences, November 7.—M. Émile Picard in the chair.—M. **Bassot**: Halley's comet. Observations of this comet were made at the Observatory of Nice on November 2 and 3. It is visible in the morning a little before sunrise. The sky was covered on the nights of November 4 and 5, but in spite of the absence of a third observation there is no doubt of the identity of the comet.—A. **Müntz**: The struggle for water between the soil and the seed. For each specific kind of soil there is a definite percentage of moisture, below which the seed, instead of gaining moisture, actually loses it. For the seed to absorb sufficient water to be able to germinate, a higher percentage of moisture, fixed for each class of soil, is necessary. Thus in a sandy soil 0·5 per cent. of water is sufficient for germination; with loams the required percentage of water is from $2\frac{1}{2}$ to 7·7 per cent., according as the proportion of clay increases; with a garden soil containing a large proportion of humus, nearly 10 per cent. of water must be present before germination can take place.—Charles **Nordmann**: A means of determining by colour photometry the parallaxes of a certain class of stars. First application to two stars. The method applied to Algol gives a distance of 59 years of light, or a parallax of 0·055″, a figure in good agreement with the 0·051″ given for this star by M. Bijourdan in his recent catalogue of stellar parallaxes. The same method applied to δ Libra gives a distance of 355 years of light and a parallax of 0·009″.—A. **Demoulin**: Certain couples of triple-orthogonal systems.—W. **Stekloff**: The development of an arbitrary function in series of fundamental functions.—L. **Favé** and L. **Driencourt**: Observations of the tides made at sea in the Channel and the North Sea. A self-recording instrument has been devised by the authors which, when placed on the sea floor, measures pressure variations directly, from which the changes of level due to the tides can be deduced. An automatic differential arrangement renders the sensibility very nearly independent of the depth. A diagram is given of observations taken at a point situated 52° 29′ N., 0° 47′ E., and the bearing of these data upon Whewell's work on the tides of the North Sea is discussed.—A. **Petot**: Unsymmetrical motors.—Eugène **Bloch**: The action of a magnetic field on the electric

discharge. The author has repeated and confirmed some experiments recently made by M. Gouy, and finds that there is a particular strength of the magnetic field which facilitates the maximum discharge. It is shown that this curious phenomenon is in general agreement with the modern theory of disruptive discharge.—J. **de Kowalski**: Progressive phosphorescence at low temperatures.—A. **Guntz** and M. **Galliot**: The preparation of crystallised strontium. A mixture of strontia and aluminium powder is placed in the lower half of a steel tube closed at one end. This is enclosed in a porcelain tube, a high vacuum being maintained in the latter. The temperature of the mixture is gradually raised to 1000° C.; after cooling, the inside of the cool portion of the tube is covered with a deposit of crystalline strontium. The yield is good, nearly 75 per cent. of the theoretical quantity, and the metal contains only 0·5 per cent. of impurities.—E. **Berger**: Tetranitromethane. This substance is obtained by the action of pure nitric acid upon acetic anhydride in acetic acid solution. The exact conditions necessary for a good yield (50 per cent. of the theory) are given in detail. The physical constants and the heat of combustion were determined.—E. **Kayser**: The influence of nitrates on alcoholic ferments. Alcoholic fermentation is more complete in presence of manganese nitrate, and for each strain of yeast there is an optimum amount of salt, the addition of which produces a maximum of diastatic activity.—G. **Malfitano** and Mlle. A. N. **Moschkoff**: The purification of starch. A 1 per cent. colloidal solution of starch is prepared, the turbid liquid frozen and allowed to melt. The clear liquid thus obtained holds in solution the greater part of the mineral impurities and very little starch; the bulk of the latter deposits in flocculent form, and can be separated by filtration or by centrifugation. After four or five repetitions of this treatment a starch is obtained which gives less than 0·02 per cent. of ash. The properties of starch thus purified are compared with those of ordinary starch. —M. **Marage**: Subjective noises in the ear. A classification of the various kinds of subjective noises in the ear in accordance with their pathological causes.—Henri **Labbé**: The distribution of nitrogen in the intestinal excreta. The dried excreta were extracted successively with various solvents, and the nitrogen determined in each extract.—S. **Lalou**: The variations in the quantity and composition of the pancreatic juice during secretions brought about by secretin. Repeated injections of secretin produce a regular secretion of pancreatic juice during a long period. The juice thus obtained is not of strictly constant composition; its alkalinity and diastatic activity diminish, this diminution being especially marked as regards the lipase.—P. **Chaussé**: Latent mesenteric tuberculosis produced experimentally in the dog. The injection of tuberculous products in the normal dog produced no visible lesions after six months. Latent mesenteric tuberculosis was, however, easily shown to exist in the majority of the dogs under experiment.—M. **Fabre-Domergue**: The food of the oyster and the mechanism of its contamination in impure water.—R. **Robinson**: Contribution to the study of the venous circulation in the lower limbs.—Paul **Marchal**: Contribution to the biological study of Chermes.—A. **Quidor**: The evolution and affinities of the Philichthydæ.—O. **Mengel**: Geology of the primary islet of La Guardia between Sègre and Noguera Pallaresa.—H. **Mansuy**: The stratigraphic succession in the neighbourhood of Luang-Prabang.—Maurice **Leriche**: The first fossil fishes met with in the Belgian Congo in the Lualaba strata.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 17.

ROYAL SOCIETY, at 4.30.—On the Effect of Gravity upon the Movements and Aggregation of *Euglena viridis*, Ehrb., and other Micro-organisms: Harold Wager, F.R.S.—The Proteolytic Enzyme of Drosera: Miss Jean White.—The Influence of Bacterial Endotoxins on Phagocytosis (including a new method for the Differentiation of Bacteria). (Second Report): L. S. Dudgeon, P. N. Panton, and H. A. F. Wilson.—On the State of Aggregation of Matter. Part I. On the Action of Salts in Heterogeneous Systems, and on the Nature of the Globulins. Part II. On the Action of Formaldehyde on Witte's Peptone. Part III. On the Solubility of Phenol and certain Crystalline Substances in Salt Solutions: Dr. S. B. Schryver.—A Method for Isolating and Growing the Leprosy Bacillus of Man: F. W. Twort.—The Oxidation of Phenol by certain Bacteria in Pure Culture: G. J. Fowler, E. Ardern, and W. T. Lockett.

LINNEAN SOCIETY, at 8.—(1) Theoretical Origin of *Plantago maritima* and *P. alpina*, from *P. coronopus*; (2) Supplementary Observations on the Theory of Monocotyledons being derived from Aquatic Dicotyledons: Rev. George Henslow.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Research Meeting. Origin of the Present Geography of Northern Nigeria: Dr. J. D. Falconer.

FRIDAY, NOVEMBER 18.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Development of Road Locomotion in Recent Years: L. A. Legros.

MONDAY, NOVEMBER 21.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Duke of Abruzzi's Karakoram Expedition: Dr. Filippo de Filippi.

ROYAL SOCIETY OF ARTS, at 8.—Industrial Pyrometry: C. R. Darling.

TUESDAY, NOVEMBER 22.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—The Arrival of Man in Britain in the Pleistocene Age: Prof. W. Boyd Dawkins, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Portland Cement, and the Question of its Aeration: H. K. G. Bamber.

WEDNESDAY, NOVEMBER 23.

ROYAL SOCIETY OF ARTS, at 8.—Methods of Detecting Fire-damp in Mines: Sir Henry H. Cunynghame, K.C.B.

GEOLOGICAL SOCIETY, at 8.—The Effects of Secular Oscillations in Egypt during the Cretaceous and Eocene Periods: Dr. W. F. Hume.—The Origin of the British Trias: A. R. Horwood.

THURSDAY, NOVEMBER 24.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Colour-blindness and the Trichromatic Theory. Part II. Incomplete Red or Green Blindness: Sir W. de W. Abney, K.C.B., F.R.S.—On the Sequence of Chemical Forms in Stellar Spectra: Sir N. Lockyer, K.C.B., F.R.S.—The Influence of Viscosity on the Stability of the Flow of Fluids: A. Mallock, F.R.S.—An Electrostatic Voltmeter for Photographic Recording of the Atmospheric Potential: G. W. Walker.—Optical Dispersion, an Analysis of its Actual Dependence upon Physical Conditions: Dr. T. H. Havelock.—The Spectrum of Halley's Comet: C. P. Butler.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Street Lighting by Modern Electric Lamps: H. T. Harrison.

FRIDAY, NOVEMBER 25.

PHYSICAL SOCIETY, at 5.—The Electric Stress at which Ionisation begins in Air: Dr. A. Russell.—On the Measurement of a Flow of Water in a Closed Circuit by a method involving little or no Statical Friction: Dr. A. Griffiths.—Exhibition of a Surface Brightness Photometer: J. S. Dow.—The Approximate Solution of various Boundary Problems by Surface Integration combined with Freehand Graphs: L. F. Richardson. —The After-glow produced in Gases by Electric Discharge: Prof. R. J. Strutt, F.R.S.

CONTENTS.

THURSDAY, NOVEMBER 24, 1910.

HIGHER ASPECTS OF ELECTRICITY.

A Treatise on Electrical Theory and the Problem of the Universe, considered from the Physical Point of View, with Mathematical Appendices. By G. W. de Tunzelmann. Pp. xxxii+654. (London: Charles Griffin and Co., Ltd., 1910.) Price 15*s*. net.

THE partial success which has attended the recent attempts of Einstein and Minkowski to found an electromagnetic system of mechanics has tended to strengthen the popular idea that the solution of outstanding problems and mysteries must be sought in the domain of electrical rather than other physical phenomena. From being a disturbing element characterised by unaccountable vagaries, the "electric fire" has come to be an all-pervading element, closely approaching the alchemist's idea of a primal substance. Mr. de Tunzelmann's work is an ambitious attempt to apply the Faraday-Maxwell theory of electricity, as modified by Larmor in the atomistic direction, to what he calls "the problem of the universe." Incidentally, the book gives a great deal of information with regard to recent work and speculation, and although the titular object of the work has not been attained (it could hardly be otherwise in our present state of knowledge), it will be valued on account of the information given on such varied subjects as electrolysis, radiation, radio-activity, the age of the earth, the solar corona, and the place of mind in the universe.

As might have been expected in a book of this kind, the interstellar ether plays a fundamental part in most of the ultimate speculations. That being so, it is to be regretted that no serious attempt was made to present the modern aspects of the various ether theories. Possibly the author may have considered the matter as too controversial. The electromagnetic principle of relativity (as distinguished from the mechanical or Newtonian one) is of such outstanding importance that it is quite impossible to state modern electrical problems without at least acknowledging its existence. Yet, neither in chapters v. nor xxii., where some statement of the principle is urgently called for, nor indeed in any other part of the work, is it even mentioned. And, although Le Sage's hypothesis and its later variants are dealt with to a remarkably full extent, there is no reference to H. Witte and his proof that the only chance for a mechanical explanation of electrical phenomena lies in the assumption of an ether composed of discrete particles.

Of minor blemishes we have "cathion" instead of "cation" (p. 19) evidently due to mistaken etymology, a micromillimetre described as "a thousandth of a millimetre" (p. 321), "coronarium" instead of "coronium" (p. 371), and plain "Norman Lockyer" (p. 644) beside the full titles of other savants. In dealing with magnetism, Langevin's important and successful theory, based upon the Zeeman effect and Curie's law, is not mentioned. In dealing with light, the author suggests calling the velocity of light in space the "radiation constant" (a term already otherwise appropriated), and (p. 271) makes out that an absorbing body absorbs less (instead of more) energy in unit time on being moved in the direction from which the light is coming.

The chapter on "The Place of Mind in the Universe," is a fascinating one, though its connection with the main work is not very obvious. The author aims at an all-embracing system or hierarchy of ultimate realities, beginning at the absolute, or eternal self-consciousness, and passing through mind, energy, and ether down to matter. The chapter is well written, and most suggestive. It is, of course, open to criticism on many points, but as few physicists have the courage to penetrate far into that borderland on the confines of which they, more than others, are wont to dwell, a spirited attempt like the present deserves every encouragement. At a time when the ether is being tried for its very existence, it is unwise to describe such a philosophic scheme as based upon a substance the properties of which, as the writer somewhat hastily asserts, "are derived from empirical observation." And when that system is further "strengthened" by a reference to the discarded "N-rays," and a single experiment in thought transference unaccompanied by the elementary safeguards devised by the Psychical Research Society, the system put forward is placed at a disadvantage from the first. Nor is that disadvantage removed by too great an insistence on the principle of the conservation of energy, and its use to assign a time-limit to the existence of the visible universe. Such a time-limit is really a negation of science and philosophy, as it implies that *deus ex machinâ* from which all scientific achievement has had to liberate itself or perish.

There are eighteen appendices on miscellaneous electromagnetic and philosophical subjects. Many of these, especially that on astronomical anomalies, are very useful and valuable.

E. E. F.

TECHNICAL DICTIONARIES.

The Deinhardt-Schlomann Series of Technical Dictionaries in Six Languages. By Alfred Schlomann. Vol. v., Railway Construction and Operation. Pp. xiii+870. Price 12*s*. net. Vol. vi., Railway Rolling Stock. Compiled by Dipl.-Ing. August Boshart. Pp. xiii+796. Price *10s. 6d. net.* (London: Constable and Co., Ltd.; Munich and Berlin: R. Oldenbourg, 1909.)

THESE two volumes form part of a series of technical dictionaries in six languages—English, Spanish, German, Russian, French, and Italian—of which seven volumes have now appeared. They are edited and compiled by Messrs. Deinhardt and Schlomann, assisted by experts from all the leading countries in each branch of the subject. The essential features of the scheme are that the six languages are all on one page, and, wherever it is possible, sketches are given so as to elucidate the text and facilitate the use of the dictionary. At the end of each volume complete alphabetical indexes are given,

five of the languages under one alphabet, and the Russian under another. The general arrangement, and the ground covered by each volume, leave nothing to be desired, and this dictionary will prove invaluable to all those who are engaged in technical work. Repeated tests of both volumes show that practically nothing has been omitted, and the long lists of contributors and revisers for the two volumes, embracing men eminent in the railway world in Europe and America, are a sufficient guarantee of the accuracy of the work. The great difficulty which often arises of finding a definition in one language which should have its exact equivalent in another has been very satisfactorily overcome, and the sketches render misunderstandings almost impossible.

In the volume dealing with railway construction and operation, only those terms are included which are of general importance in such work; such details as earthworks, bridge-construction, &c., could only be exhaustively treated in volumes specially reserved for them. Nevertheless, the railway expert will find that such subjects have been quite adequately treated so far as he is concerned in this volume. In preparing this volume, the subject has been divided into sections to facilitate reference; these sections include track, permanent-way, connections between tracks, stations, signalling, and safety appliances, railway service, &c., and one special section has been given to electric railway installations. Each section is again divided into a large number of subsections, and, as these are given fully in the table of contents, it will be realised how much care has been taken to facilitate reference. It is essential to those who are engaged in the work of translating or making extracts from foreign technical books and journals that any technical dictionary should be so arranged that no time should be lost in ascertaining the ordinary English equivalents to any unknown foreign words or expressions; the alphabetical index at the end of each volume ensures this, and the division of the whole subject into sections and subsections still further makes for simplicity and saving of time.

The sixth volume is given up entirely to the important subject of railway rolling stock. Here, again, the subject is divided up into a series of sections, such as common equipment for locomotives and carriages, including such details as wheels, axles, drawbar and buffer gear, brakes, &c.; locomotives and motor coaches; carriages; systems of lighting trains; rolling stock for electric railways; and, lastly, railway workshops. This latter section is not, of course, intended to cover the subject of machine tools generally, but only in so far as special methods and working are employed in railway workshops.

With the help of these two volumes, the railway engineer, and all those who are concerned with the various industries which are devoted to the manufacture of the machinery and plant required for the working and upkeep of the railways of the world, will find that the task of keeping abreast of what is being done in other countries will be greatly facilitated. It is essential that every manufacturing firm should endeavour to learn from the technical Press what is being done in other lands, and a thoroughly trustworthy technical dictionary, such as this series now in course of publication, is indispensable for this purpose. These volumes should be found in the head office of every firm which aspires to keep itself up to date in business methods.

T. H. B.

PHYSICAL CHEMISTRY IN ITS GEOLOGICAL APPLICATIONS.

Principles of Chemical Geology: a Review of the Application of the Equilibrium Theory to Geological Problems. By Dr. J. V. Elsden. Pp. viii+222. (London: Whittaker and Co., 1910.) Price 5*s*. net.

ALTHOUGH it is generally recognised that the new physical chemistry has far-reaching applications in geology, no less than in other branches of science, little has yet been done to bring this home directly, either to the working geologist or to the student. In Van 't Hoff's lectures on "Physical Chemistry in the Service of the Sciences," the only geological application discussed is that relating to the crystallisation of salts from sea water. The results of the chemist's beautiful investigation of this one problem are the first-fruits of work on these lines, and they serve to show how wide a field still remains to be harvested. Vogt and others have essayed to apply the laws of solutions to igneous rock-magmas, but in this much more difficult problem no more than a beginning can yet be recorded. Meanwhile, we suffer from that want of touch between workers in different branches of science which is one of the less happy consequences of specialisation. The chemist has, in most cases, little acquaintance with geological questions, while the geologist, of the older generation at least, has not usually a working knowledge of physical chemistry, or at best is unfamiliar with the specific results which have been obtained.

This gap Dr. Elsden has now endeavoured to fill. The book before us is a compendium of physico-chemical principles as applied to the more important questions of chemical geology and petrology. In accordance with this plan, the arrangement adopted is primarily a chemical one, thus differing from the older method of Bischof and others. Successive chapters deal with the crystalline and amorphous states, viscosity, diffusion, solution, surface-tension, vapour-pressure, polymorphism, and mix-crystals. Throughout the author insists that the key to the many problems here touched "lies in the determination of the conditions of equilibrium," and indeed this last word occurs in the heading of almost every chapter. Unfortunately, as is duly recognised, many geological phenomena (such, *e.g.* as the glass in volcanic rocks) prove that the adjustment of equilibrium may be indefinitely delayed.

A surprising amount of matter is brought together in the compass of these two hundred pages, and the numerous references given in footnotes will be very useful to the student. Sometimes, perhaps, this fulness is gained rather at the expense of clearness of treatment; or it may be merely a wholesome caution which makes the author content to cite conflicting opinions and leave the question at issue open. In

general, we are given an admirable, if condensed, summary of the subjects dealt with, though in places a critic may pick out a carelessly written sentence, *e.g.* the dictum (p. 2) that "no substance can at once possess both vectorial and scalar properties." Any work treating of a new and rapidly developing subject must inevitably contain statements which have become obsolete even before their publication, and in a second edition Dr. Elsden will doubtless revise such passages as those relating to quartz and tridymite (p. 104), amphibole and pyroxene (pp. 111 *et seq.*), and lime-olivine (p. 203). Meanwhile, the book, in addition to its intrinsic value, will attain the author's expressed desire to stimulate interest in this important branch of geology. A. H.

THE MAKING OF GARDENS.

Hardy Plants for Cottage Gardens. By Helen R. Albee. Pp. vi+309. (New York: Henry Holt and Company.) Price 1.60 dollars net.

THIS volume forms part of the American Nature Series: Group iv., Working with Nature. From the title one would expect to find the work severely technical and somewhat dull—"dull and useful as work clothes and garden boots," as the author herself describes a certain chapter. But the title, though appropriate for a section of the work, is to some extent inadequate, as the book proves to be an essay on garden-making, written in a light and racy style, reminiscent of Charles Dudley Warner's delightful "My Summer in a Garden."

The greater part of the volume is devoted to a detailed account of the evolution of the author's garden, through the various stages "In the beginning," "An incipient garden," "The garden grows," "My ambition grows," and gliding on by easy transition to such apparently inconsequent subjects as "the vices of plants" and "some gardeners I have known." But though the author in her narrative of the six years' labour involved in the formation of her garden ranges over a wide field of horticultural economy, the sequence is so easy and natural that the reader's interest is not allowed to flag, and it is with regret that one reaches the classified lists which occupy the last 122 pages of the book.

These lists are conventional, and call for little comment. The method of classification adopted, though at first sight somewhat complex, will probably facilitate reference. The lists comprise a selection of shrubs and perennials, with descriptions and brief cultural directions, and are arranged primarily under colour headings, and, secondarily, according to the months in which the plants flower. A selection of annuals arranged according to the same system follows. It may be pointed out that this might have been incorporated with the shrubs and perennials, thereby avoiding a somewhat bewildering multiplicity of headings. The work is profusely illustrated with views of the author's garden at various stages, and a copious index is provided.

The author has not laid down hard and fast rules for the formation of a flower garden. Nor does she desire that others should follow slavishly the lines on which she has worked. "It is not well to imitate another's work, but to follow where your own conditions lead." Her experiences are related with a view to stimulating others who may have the opportunity and the desire to create a garden after their own heart, but who may lack the courage to break away from the conventional or who are diffident as to their ability to shape a new course for themselves. By such the book will be found rich in suggestion. Above all is it a plea for the free play of imagination in the garden.

"No one should have a garden which grows nothing but flowers, and yields no other recompense to the gardener except successful plants. Over, beyond, and above must hover the spirit of poetry, of wonder, of mystery; otherwise there comes a day of disillusion when you awaken to the weariness, anxiety, and watchfulness, and begin to measure the reward. You need a larger insight, something that connects your efforts with the universal in nature, the ideal, the soul of things. Into this you may lift the garden, and at once drop the tired body and soiled hands, and the whole material aspect of labour."

PHARMACEUTICAL PRACTICE.

The Extra Pharmacopoeia of Martindale and Westcott. Revised by Dr. W. Harrison Martindale and W. Wynn Westcott. Fourteenth edition. Pp. xxvii+1054. Price 12*s.* net. With supplement, *Organic Analysis Chart.* By W. H. Martindale. Pp. 80. (London: H. K. Lewis, 1910.) Price 3*s.* 6*d.* net.

THIS handbook, which is so familiar to medical and pharmaceutical practitioners, appears in its fourteenth edition in a slightly altered form, the size of the pages having been enlarged so as to allow of the inclusion of new matter without increasing the thickness of the book. It will, however, still fit comfortably in the coat pocket, which is not an altogether unimportant advantage.

The two years that have elapsed since the appearance of the thirteenth edition have yielded an unusual amount of valuable therapeutic literature, a judicious condensation of which forms, for the most part, the new matter of the fourteenth edition. There are new chapters upon lactic acid bacilli therapy, organic arsenic compounds, the electrical introduction into the tissues of medicaments in the ionised condition, and radiology. In addition, the most recent information relating to a number of new pharmaceutical and chemical preparations is incorporated, and recent progress in vaccine therapy, cancer research, trypanosomiasis, and the treatment of tuberculosis is noted. The results of the chemical and bacteriological inquiry into the value of disinfectants undertaken by *The Lancet* commission are summarised.

The above is a brief outline of the extent of the revision in so far as it is of direct interest to the medical practitioner, but it may be added that throughout the book there is evidence that the authors have scrupulously followed the medical literature of the past two years. Alterations which enhance the usefulness of the book to pharmacists are by no means inconspicuous. Details are given of about a hundred more patent or proprietary medicines than in the last

edition. The authors have indicated by means of signs the part of the poison schedule in which each poison falls; this is an innovation which will be welcomed by retail dealers in poisons, in view of the exacting nature of the Poisons and Pharmacy Act, 1908. Since the last edition was published, new issues of various foreign pharmacopœias have appeared, and these have been utilised where necessary in the preparation of the fourteenth edition.

The "Organic Analysis Chart," which is published as a supplement, is intended to assist the analyst in the recognition of a number of organic chemicals, both natural and synthetic, used therapeutically. This chart gives the results of the examination of more than three hundred substances, and is the outcome of work conducted in Mr. Martindale's laboratory. It is a useful addendum to a book which is indispensable to practitioners of medicine and pharmacy.

A FISHERMAN'S TALES.

An Open Creel. By H. T. Sheringham. Pp. xii+305. (London: Methuen and Co., Ltd., 1910.) Price 5*s.* net.

MR. SHERINGHAM'S contributions to angling literature are always welcome, and we are glad to find that he has published in book form—or, more accurately, has worked up with other materials into a book—some of his contributions to *The Field*. No one need hesitate to look into the "Open Creel"; they will find plenty of fish, some hundredweight and a half of trout, nearly as heavy a bag of salmon, and chub, pike, and bream by the stone. In the preface we are promised that we shall find no plethora of fish in the succeeding essays, and Mr. Sheringham would not have himself regarded as an over-successful angler; to the ordinary reader he certainly seems successful beyond the wont of fisherman, but success in angling, as in other walks of life, is seldom undeserved, and it is with interest that we look for its explanation in our author's own account of his adventures. This is to be found, we venture to think, in his persistency, and his advice to others is to persevere; he who would come home with a heavy basket must needs set forth "with patience and perseverance and a bottle of sweet oil," as the snail went to Jerusalem. Yet it was his oil bottle that so tried Mr. Sheringham's patience that it came within a little of ending an honourable career in the Coln at Bibury.

It would be invidious to select for praise any one essay in the book. "The Float" is excellent, so, too, are the accounts of "Some Kennet Days," and the obituary notice of "Two Colne Trout," and so are many others. Perhaps it is when he fishes for coarse fish that Mr. Sheringham is the best company; such fishing is a more leisurely pursuit, and leaves more time for contemplation and for those digressions into the byways of angling that show him at his best. Sometimes when dry-fly fishing he tends to become a mere compiler of lists of dates and waters, flies and weights of fish, yet he is never wearisome, and has a most amiable weakness for Wickam's Fancy. Did fly fishing give him leisure for contemplation, Mr. Sheringham might meditate upon the problem thus presented; we cannot help thinking that a man's character should be reflected in his taste in flies, and that he who loves Wickam's Fancy must be a happy and contented soul and a good companion at the water's side. At any rate, we have found him good company in print, and recommend others to see if they cannot do likewise.

L. W. B.

OUR BOOK SHELF.

The Photography of Moving Objects and Hand-Camera Work for Advanced Workers. By A. Abrahams. Pp. 153. (London: G. Routledge and Sons, Ltd., and Dawbarn and Ward, Ltd., n.d.) Price 1*s.* net.

MR. ABRAHAMS has been known during the past few years as a very successful photographer of moving objects, especially those in rapid motion, and in this volume he describes his methods freely and fully. He illustrates his experiences with more than forty pictures, which are well reproduced, and these, if nothing else were known of Mr. Abraham's work, would demonstrate his right to speak with authority. After chapters on apparatus, exposure, development, and so on, he deals with the photography of railway trains, athletics, rowing, football, cricket, lawn tennis, horses, divers and swimmers, golf, common objects, winter sports, special subjects, and press photography, giving apparently all the practical details that can be given in a book.

It is of interest that Mr. Abrahams prefers pyrogallol with sodium carbonate and sulphite as developer, in spite of all the new reagents that have been introduced, and that he actually blames metol as the cause of a modified instead of a full success. He advocates swinging the lens when necessary to get better definition of details at various distances from the camera, and justifies his advice by means of at least one example. But when he says, "if you cannot swing the back why not swing the lens," he appears to support the common idea that the one is the equivalent of the other. There is, of course, the radical difference that swinging the lens moves the axis of the lens to a different part of the plate, while swinging the back does not. There is one other common error to which the author appears to lend support, when he says that the shutter-blind "should be really *in the focal plane*"; an obvious impossibility, because the plate itself is there.

Der Sternenhimmel. By Prof. J. D. Messerschmitt. Pp. 195+xiii plates. (Leipzig: Philipp Reclam, Jun., n.d.) Price 1.75 marks.

THIS little book is another well-meant attempt to interest the public in astronomical phenomena by describing in simple language some of the results obtained by continued observation. The general appearance of the sky and the changes produced by the diurnal rotation and annual revolution of the earth about the sun come under notice. Separate chapters are added on parallax and aberration, the precession and nutation of the earth's axis, and the variation of latitude, which last seems a small matter to introduce into a work that can only aim at presenting the more conspicuous features. The several planets are described, their general appearance and motion, and a few remarks are added on comets and meteors.

In the section devoted to the stellar system, the usual information is given concerning double and variable stars, clusters, and nebulæ, proper motion and the movement of the solar system in space. The ground covered is that with which we have been made familiar by many similar works, and it is not a little difficult to justify the appearance of another treatise

on popular astronomy, however accurate it may be in detail. No doubt it is always difficult to know what to omit when space is severely limited, but if the book is to attract the attention of those who are unacquainted with astronomical literature, we suggest that the object would be more likely to be attained if the author had devoted some space to the methods and results of spectroscopic observation. By practically ignoring this large section, he has neglected perhaps the best means of exciting the scientific imagination and awakening an intelligent curiosity in celestial phenomena.

Introduction to Physical Chemistry. By Prof. H. C. Jones. Pp. xv+279. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1910.) Price 1.60 dollars net.

IN this book the author gives a rapid sketch of what is ordinarily known as physical chemistry. Compared with other books of its kind, the result can scarcely be described as satisfactory. The author has tried to cover too much ground in the allotted space, with the result that much of the information is of a fragmentary character. The book is evidently intended for junior students, but it is doubtful whether they would really get any grasp of fundamental principles from such a highly condensed account of physical chemistry.

There are many places where the author's statements are vague, if not erroneous. For example, when discussing solids, he says, "The density of solids is somewhat greater than that of liquids, and much greater than that of gases. This is just what we should expect, since the solid state represents matter in its most condensed form." The second sentence is quite misleading. Again, "Ozone seems to be stable below 200° and above 1000°." Prof. H. C. Jones is a zealous and energetic worker in the field of physical chemistry, and the reviewer would like to have been able to accord this book a hearty welcome. As it is, he feels bound to say that, although it may serve a useful purpose, there are, in his opinion, better works of a similar character already in existence.

Preliminary Physiology. By W. Narramore. Pp. xix+220. (London: Methuen and Co., Ltd., 1910.) Price 3s. 6d.

THIS little book will be mainly useful to school teachers and to junior students preparing for the first-stage examinations of the Board of Education. This class of reader has but little preliminary anatomical knowledge, and the bulk of Mr. Narramore's book is occupied with filling up this gap. There are many other excellent books of the same nature, but the chief merits of the present volume are—(1) it is correct so far as it goes, and it is admittedly of the most elementary nature, and (2) it is provided with excellent illustrations. The author recognises that books and pictures will never teach properly even the elements of an experimental science, and insists that practical work must accompany the course. One can only hope that this expression of opinion will bear fruit. So far as one's experience of the schoolmaster goes, it is just that practical element in his scientific training which is usually conspicuous by its absence.

W. D. H.

The Invicta Table Book. By J. W. Ladner. Pp. 18. (London: George Philip and Son, Ltd., n.d.) Price 2d.

GRAPHIC representations of the multiplication tables and of the commoner weights and measures—including the metric system—are provided, and these should prove very useful in schools where the compiler's number scheme is adopted.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Jodrell Laboratory at Kew.

THE award of a Royal medal to Prof. F. O. Bower for his long-continued researches in the vascular cryptogams suggests to me that it may not be inappropriate to put on record an anecdote in our scientific history in the last century.

In the fourth report of the Commission on Scientific Instruction and the Advancement of Science it was recommended (paragraphs 57 and 154) "that opportunities for the pursuit of investigations in Physiological Botany should be afforded in the Royal Gardens at Kew."

To this the Government paid as little attention as it usually does to the results of the labours of Royal Commissions. But the recommendation was not wholly fruitless, for it induced the late T. J. Phillips Jodrell, a personal friend of Sir Joseph Hooker, to offer to build and equip, at an expense of 1500*l.*, a modest laboratory for the purpose. As stated in the Kew report for 1874, it was originally intended that this should be associated with an extension of the herbarium building which was contemplated at the time; but in consideration of the risk of fire it was decided to have an isolated building contiguous to the propagating department of the establishment.

It was completed in 1876, and was first occupied by Prof. Tyndall for work on the putrefactive changes produced by bacteria, the results of which were published in the Phil. Trans. for the following year.

Since then the stream of research has continued steadily. I "handed in" to the "Botanical Work Committee" appointed by the Treasury in 1900 a list of published papers as the result of work done in the laboratory down to and inclusive of that year, and compiled from copies preserved in it.

The workers in the Jodrell Laboratory are, of course, independent. They are supplied with the material they require, and are at liberty to make use of the Kew library and to consult, if they care to do so, the scientific staff. The nature of the work has therefore been of the most varied kind, and does not represent the influence of any particular school. In this respect the outcome differs from that of an academic laboratory in which research is carried on under the direction, or at any rate with the aid of, the professor.

What I think is worth noting is that, of those who have worked in the Jodrell Laboratory during the fifteen years from 1876 to 1900, no fewer than six have subsequently received the Royal medal. I do not mean to say that it has been in each case wholly earned at Kew, but it is I think clear that the work done there has contributed to the result.

The following are the names, with the general scope of the research and the date of the award:—Burdon Sanderson, electromotive properties of Dionæa, 1883; Marshall Ward, embryology and mycology, 1893; Gardiner, continuity of protoplasm, 1898; Horace Brown, assimilation of carbon, 1903; Scott, fossil botany, 1906; Bower, morphology of vascular cryptogams, 1910. To these may be added, making in all seven medallists, the Davy medal awarded to Schunck in 1899, in part for his researches on chlorophyll.

When one considers the names the results are not surprising, and though Kew enjoys some measure of prestige from being associated with them, that association is to a large extent accidental, at any rate limited to affording facilities. But some conclusions may be drawn. In the first place, the prevision of the Royal Commission is amply justified. In the next place, Phillips Jodrell, were he alive, would have every reason to be satisfied with the outcome of his generosity. But there is a further and more important point. I do not contend that the work I have enumerated was necessarily bound up with the Jodrell Laboratory in the sense that it could not have

been accomplished elsewhere, as, indeed, much of it has been continued. Of course, the medallists were all picked men, who did not lightly embark on research demanding much time and labour without a good deal of previous consideration. I think it may be fairly concluded that the provision of facilities with a sympathetic atmosphere may have operated as a determining influence. The final moral of the story may be summed up as the "open door."

And this applies elsewhere. The mathematician only requires his study. The physicist and the chemist are rarely at a loss for opportunity of research. But the position of the biologist is different. He must go to his material. Such institutions, therefore, as the Rothamsted Experimental Station, the Plymouth Laboratory of the Marine Biological Association, and the Biological Station at Naples, are peculiarly deserving of public support. And I think the story of the Jodrell Laboratory affords tolerable ground for the presumption, if, indeed, other experience did not afford it, that the generosity of those who have money to spare will not be fruitless in results if extended to institutions of the kind.

I cannot, however, omit to notice one piece of devoted service to the interests of the laboratory which, of its kind, is almost unique. A quarter of a century ago the Government looked with more indifference on research than happily it does at present. It merely acquiesced, with little interest, in a laboratory being provided at Kew from private funds. It was hopeless at the time to obtain for it any public financial support. Posterity will almost think it incredible that from 1892 to 1906 Kew should have had to owe to the present president of the Linnean Society, Dr. Dukinfield Scott, the unpaid performance of the duties of keeper. Such unrequited devotion has scarcely received the recognition it deserves. Fortunately, the utility of the laboratory as a necessary element in the Kew establishment has become sufficiently evident, and the keeper is now a member of the paid staff.

Witcombe. W. T. THISELTON-DYER.

Eel-larvæ (*Leptocephalus brevirostris*) from the Central North Atlantic[1]

IN a previous article in NATURE (November 10) I have given some information about the expedition executed by the steamer *Michael Sars* in the North Atlantic, from April to August this year, under the superintendence of Sir John Murray and myself. As would be seen from that article, the expedition crossed the Atlantic twice, first from the Canaries to Newfoundland, and then from Newfoundland to Ireland. During this cruise many hauls were made with pelagic tow-nets and trawls. It is characteristic of the manner of work that many nets and trawls—as many as ten—were towed simultaneously during several hours at each station. The nets and trawls were fixed on the wire as follows: one at the surface, the others at 100, 200, 300, 600, 1000, 1500, 2000, 2500, and 3000 metres. The very considerable number of pelagic forms captured is now being examined. The material includes several hundred Leptocephali belonging to many different species. Among these are forty-four larvæ of the common eel (*Leptocephalus brevirostris*). The localities where these were found are so interesting that a preliminary note may be useful, as suggestive for further investigation.

The accompanying chart (Fig. 1) shows the stations at

FIG. 1.—Chart showing places where eel-larvæ were found, and the number caught.

[1] Communication from the *Michael Sars* North Atlantic Deep-sea Expedition, 1910.

which eel-larvæ were found, the figures indicating the number of larvæ caught at each place. The chart shows the existence of eel-larvæ over the greater part of the North Atlantic between North Africa and North America. The excellent Danish investigations planned by Dr. C. G. Joh. Petersen, and carried out by Dr. Johannes Schmidt, succeeded with Dr. Petersen's young-fish trawl in catching eel-larvæ over depths mostly of 1000 metres along the continental slope from Shetland to Gibraltar. On the American side, larvæ of the American eel (*Anguilla chrysypa*) have already been found over the continental slope off the United States. The catches made by the *Michael Sars* now have this particular interest, that they prove the distribution of the larvæ, not only on the slopes, but also in mid-ocean over the greatest depths, both over the deep eastern and western basins and over the Azores ridge separating them.

According to their length, the larvæ may be divided into two distinct groups, one including specimens of 41 to 60 mm. in length, the other those of 66 to 82 mm. (see Fig. 2). All the specimens belonging to the first group, twenty-one altogether, were found at the stations south of the Azores, marked by a cross, and all those belonging

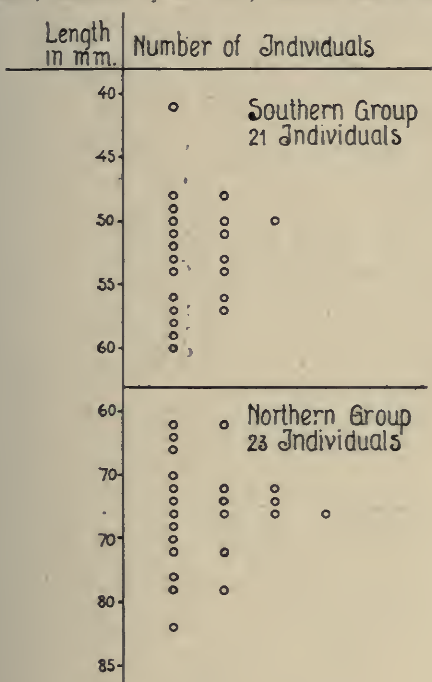


FIG. 2.

to the group of larger individuals were caught at the stations north of the Azores, marked by a circle. In order to control the determination of the larvæ, my assistant, Mr. Einar Lea, has counted the myomers of all the larvæ, and the results are given, for both groups separately, in Fig. 3. All the individuals—of either group—have a number of myomers not exceeding the limits, 111 to 119, given by Dr. Schmidt as characteristic of the larvæ of the common eel (*Leptocephalus brevirostris*). They are thereby distinguished from the larvæ of the American eel (*Anguilla chrysypa*). For the larvæ of the latter Eigenmann and Kennedy give the number of myomers as 105 and 108, and Dr. Schmidt has, by counting the vertebræ, fixed the limits at 104 and 110.

The larvæ of the common European eel previously found by Dr. Schmidt in the North Atlantic were all either full-grown leptocephalic larvæ or in subsequent stages of transformation. Dr. Schmidt describes five different stages. All the larvæ found by the *Michael Sars* north of the Azores belong to one or other of these stages. Outside the continental slope no larvæ of the transformation stages were found, but only full-grown leptocephalic larvæ corresponding to Dr. Schmidt's stage 1. This holds good both for the larva found in April in the Bay of Biscay and for the larvæ found in July between Newfoundland and Ireland. On the continental slope off the British Isles, however, larvæ in transformation stages (Schmidt's stages 2 and 3) were found.

The larvæ found by the *Michael Sars* south of the Azores are all smaller than the full-grown leptocephalic

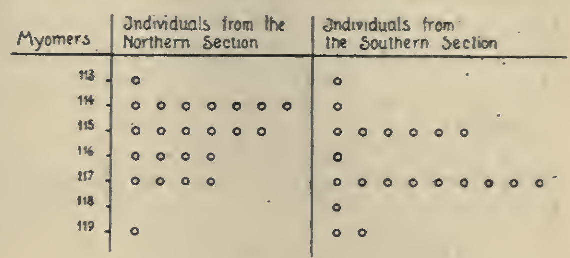


FIG. 3.

larva. I understand them to be stages in the development from the ovum to the full-grown larva. All have teeth which in every essential correspond to those characterising stage 1, as described by Dr. Schmidt. I must therefore consider the larvæ caught south of the Azores to be younger than any before found.

So far, no other stages have been discovered among the materials secured by the *Michael Sars*. More material is therefore needed to give a full explanation of the facts stated above. As, in the numerous Danish investigations and in all the hauls made by the *Michael Sars*, no single specimen belonging to the youngest stages has been found in the area north of the Azores, the conclusion seems natural that the spawning area of the eel must be sought in the southern central part of the North Atlantic. However, the spawning area can only be located by the evidence

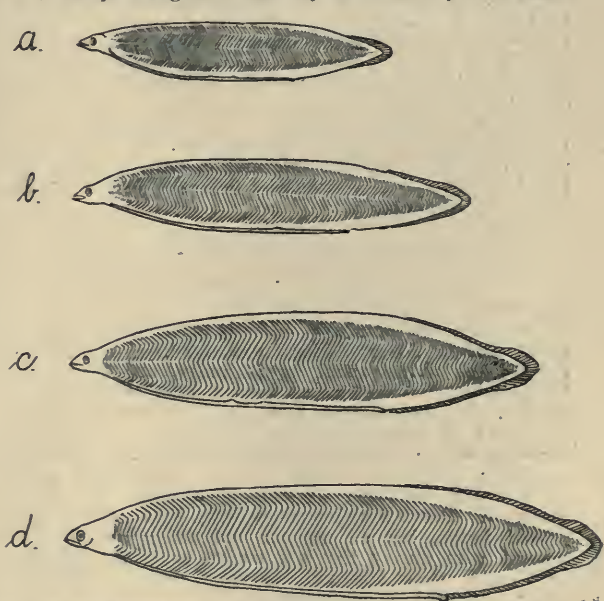


FIG. 4.—Eel-larvæ found by *Michael Sars*; *a–c*, caught south of the Azores; *d*, north of the Azores; *a*, the smallest larva found; *d*, a full-grown larva as the youngest previously found. All the figures are copied from photographs. Nat. size.

of ova. So long as the eggs have not yet been discovered the spawning area must also be considered as unknown; but it is natural to look for it in the neighbourhood of those localities where the youngest stages have been found. The discovery of the ova would not only give information about the geographical position of the spawning area, but also about the ages of the different larvæ hitherto found. It may then be possible to understand the distribution of the different stages—the youngest south and the eldest

north—as a drift with the currents. The negative fact that none of the smaller larvæ have appeared north of the Azores, and none of the larger ones south, seems to favour such an explanation. The further fact that none of the transformation stages, previously found so abundantly on the continental slope, were found in mid-ocean supports the same view. Nevertheless, I consider it dangerous to form any definite opinion from negative facts concerning such vast ocean expanses, where so few investigations have as yet been made.

As a provisional working hypothesis I should be inclined to regard the continental slope as the area where the transformation of the larvæ takes place, and the southern central part of the North Atlantic ocean as the probable spawning area of the eel.

Fig. 5 gives information as to the depths at which the *Michael Sars* caught the eel-larvæ. The youngest specimens were mainly found by towing a net with 100 metres

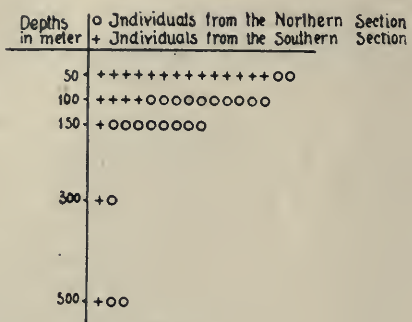


Fig. 5.

of wire out, or in a depth of about 50 metres. The eldest stages were found in nets towed with 200 metres of wire out, or at a depth of about 100 metres. The *Michael Sars* employed for these depths mostly silk nets with mouths of 1 m. in diameter, and no trawls. Otherwise larger catches of eel-larvæ might have been procured. I should recommend that future investigators look for the eggs and the smallest larvæ from the surface down to 100 metres, say between the Azores and Bermudas, in winter. I hope that this information will in this way be found useful.

Johan Hjort.

Bergen, November 7.

Are Mules Fertile?

In the *Nuevo Mundo* of Madrid for October 27 it is stated that a mule, belonging to Don Carlos Gimenez, of Argamasella de Calatrava, recently gave birth to a foal. From India, South Africa, and America reports have reached the writer about fertile mules, but in no single instance has the evidence of fertility been altogether satisfactory. In the present case the information thus far submitted is very meagre. Nothing is said about the breeding of the reputed parent of the foal. She may be a she-ass with the conformation of a mule, or a mule in milk which succeeded in stealing a mule foal from a mare. A Przewalsky-horse hybrid bred at Penycuik proved fertile, but all the ass and zebra hybrids experimented with during the last twelve years proved sterile. The male zebra-horse hybrids were sterile because they never succeeded in maturing perfect sperms. The hybrid "Romulus," *e.g.*, had all the instincts of a pony stallion, and, so far as one could judge with the naked eye, he was capable of getting foals. When, however, a microscopic examination was made, it was ascertained that the sperms were quite or almost tailless—at the most the length of the flagellum was never more than three or four times the diameter of the head, and it was immobile. Why female mules are infertile has not yet been determined.

Sterility in birds seems sometimes to be due to structural changes in the germ cells induced by in-and-in-breeding. It is conceivable that similar changes may sometimes result from intercrossing. It must be admitted that the photograph reproduced in the *Nuevo Mundo* supports the view that the Calatrava foal is a mule, and that the reputed mother is also a mule.

But further and more definite information is wanted before a decision can be arrived at.

J. C. Ewart.

The Origin of Dun Horses.

The cases quoted by Prof. Cossar Ewart from Mr. J. B. Robertson in Nature of November 10 would be good evidence against the theory that every dun horse must have at least one parent dun or grey if the data in the Thoroughbred Stud-book were absolutely trustworthy. This they are not, and all the cases quoted by Prof. Ewart have in them a very considerable element of doubt. Let me indicate these elements by placing the cases quoted in one column, in reversed chronological order, and the necessary remarks in another column parallel.

Cases Quoted.	*Remarks.*
Bay-dun filly, foaled 1907, dam, Unexpected.	This filly is registered "b. or dun."
Dun colt, foaled 1897, dam, Lobelia.	This colt is registered "b. or dun."
Dun filly, Sarah Curran, foaled 1892, dam, Cellulites.	In vol. xvii. Cellulites' foal of 1892 was said to have died, but in vol. xviii. the alleged dead foal becomes Sarah Curran.
Light dun filly, foaled 1886, dam, Danseuse.	This filly is registered "bay."
Dun or chestnut filly, Saneta, foaled 1884.	The breeder had doubts as to this filly's colour.
Dun filly, foaled 1829, dam, Octavia.	This filly died when two days old.
Dun filly, foaled 1763, dam, Miss Thigh.	This filly had eight foals the colours of which were registered, and not one was dun.
Dun colt, foaled 1730, dam, Young Kitty Burdett.	This colt's sire was grey.

The last case quoted is the mare Silverlocks, from which nearly all the duns in the Stud-book are descended. Silverlocks is credited with five foals, the first of which was foaled in 1738, and four of these were dun. Three of these four were by a bay or brown horse. So Silverlocks herself was presumably a dun. The Stud-book assumes that this mare Silverlocks was identical with a chestnut mare Silverlocks foaled in 1825. Either the 1825 Silverlocks was a dun, not a chestnut, or the two mares were different animals.

James Wilson.

Royal College of Science, Dublin, November 15.

The Cocos-Keeling Atoll.

In stating the depths to which the bores in the Funafuti lagoon were carried, and in drawing his deductions from them, the reviewer (Nature, November 10) has fallen into a very curious error. He states that the first bore was driven to a depth of 41 fathoms, and the second to nearly 36 fathoms, but he overlooks the fact that he is giving the measurements from the surface of the lagoon water, and not from the lagoon floor.

The bores were started in 101 feet of water at low-water spring tide, and therefore, of the 41 and 36 fathoms mentioned by the reviewer, the top 17 fathoms in each case consist of nothing but lagoon water. The actual bores made into the lagoon bed penetrated no more than 24 and 19 fathoms respectively, or, as I pointed out in my last communication, a maximum of 144 feet.

F. Wood-Jones.

My depths of 41 and 36 fathoms were not intended in any way as a correction of Mr. Wood-Jones's letter. The important point is that lagoon débris *only* occurred above 27 fathoms; there was 10 fathoms of it. Below this depth we get coral rock.

It is a long time since any discussion has been held in this country on coral-reef formation, while much work

has been done during the last decade. I suggest that a public discussion, such as that on "The Origin of Vertebrates," held at the Linnean Society last session, would be valuable.

The Reviewer.

In our work in Challenger Office in connection with deep-sea deposits, we are very much impressed with the fact that solution of calcium carbonate is going on in the ocean, not only at great depths, but at all depths from the surface to the bottom wherever dead organisms which secrete carbonate of lime are exposed to the action of the sea water, as was recognised and insisted on by Semper, Murray, Agassiz, and others. We are therefore much interested in the discussion going on in Nature regarding solution in the lagoons of atolls.

Mr. Wood-Jones considers that there are no actual proofs of solution in the lagoons of atolls, but, at the same time, admits the deposition of calcium carbonate.

The quantity of calcium carbonate present in solution in normal sea water is very small—only 0·12 gram per litre for water of specific gravity 1·026—and *no* precipitate is obtained on allowing it to stand for any length of time. When, however, sea water has remained for some period in contact with calcium carbonate it may take up a greater amount (up to 0·649 gram per litre). The solution is then supersaturated, and, on being allowed to stand, calcium carbonate is deposited in the crystalline form, and the deposition may go on until the solution contains less than is normally present in sea water.

The first condition, therefore, for precipitation is that *more* calcium carbonate than is normally present should pass into solution, and this can only occur when the sea water is in contact with a calcareous deposit for some time.

Would Mr. Wood-Jones say where the calcium carbonate which is precipitated in the crystalline form in the interstices of the massive corals in the lagoons comes from, for it is certainly not from the normal sea water which reaches the reefs from the open ocean?

It would appear that Mr. Wood-Jones's arguments against Sir John Murray's theory go rather in support of it.

Madge W. Drummond.

Challenger Office, Villa Medusa, Boswell Road, Edinburgh, November 17.

The Flight of Birds against the Wind.

In an interesting article (Nature, November 10) upon bird migration and Mr. Power's recently published "Ornithological Notes," Sir T. Digby Pigott expresses surprise at the latter's conclusions that in the large autumnal migrations the birds invariably fly "almost directly against the wind even when it approaches a stiff breeze."

My observations on the flight of gulls during south-west gales off this coast lead to the conclusion that these birds during their aërial gyrations either face the wind or fly obliquely across the current. They very rarely fly, and, I believe, never soar, with the wind behind them. Perhaps less muscular energy is necessary in the former than in the latter case. Fish in rapid rivers, when not actively moving, according to my experience remain with their heads upstream.

W. Ainslie Hollis.

Hove, November 15.

THE ACCURATE MACGILLIVRAY, ORNITHOLOGIST.[1]

"THE accurate MacGillivray" is Darwin's designation of the subject of this notice, and "ornithologist" is the title which, when twenty-three years of age, he himself presaging his own powers, declared it would go hard with him if he did not merit.

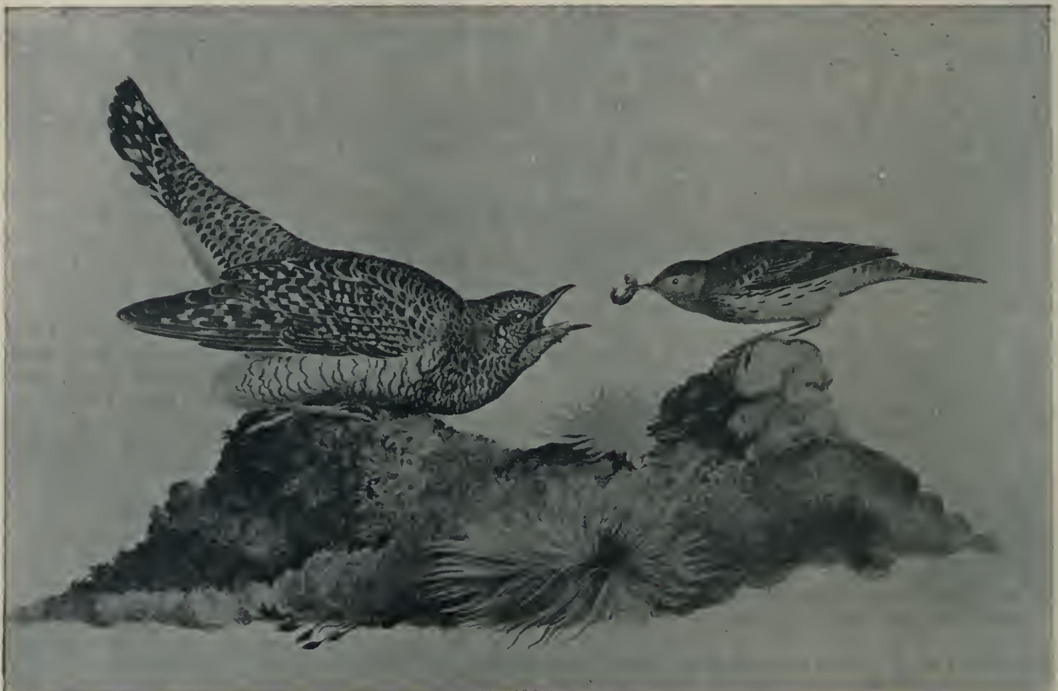
Who MacGillivray was does not require to be told to the ornithologist conversant with the literature of his subject; but the general reader and the superficial bird-man have probably never heard his name. Yet that he was "the greatest and most original ornithological genius save one . . that this island has produced," is the verdict of so distinguished an ornithologist of our day as Newton. Why MacGillivray's biography should have tarried until his ashes had been fifty-eight years in the tomb is hard to understand, except probably that, born before his time, his contemporaries failed to perceive the genius of the man, or realise the pioneer he was.

William MacGillivray, born in Aberdeen in 1796, was the son of a military surgeon who died on the field of Corunna. The story of his self-denying life is that of not a few Scottish students, who, scantily provided with means, have yet by their indomitable will-power and love of learning achieved distinction, honour, and lasting fame. The future ornithologist's boyhood, from the age of three, was spent in Harris, in the Hebrides, where nature is wild and presents herself in many changing and impressive aspects. In the parish school a few miles from his home, he obtained, "under dull scholastic rule," a good elementary education, but his chief and unconscious preceptors were "the solitudes of nature" and "the moaning voice of streams and winds." At the age of eleven he set out for Aberdeen, to prepare, under more advanced tutors, for his entrance the following year into the University there, with a view to his father's profession. He probably on this occasion, as he invariably did at the beginning and end of the various college sessions, walked all the way athwart Scotland from his landing place on the west coast. When twelve years old he entered King's College, at that time the University of old Aberdeen (as then known), which (until 1860) was distinct from Marischal College, the University (junior by a century) of new Aberdeen. Having graduated M.A., when four years older, he proceeded at once to the study of medicine, of which one of the courses was botany, and with it, as he has recorded, he first began the study of nature "which has been particularly fascinating." A year later he took up zoology. His vacations were thenceforth spent in pedestrian excursions over the Highlands and islands, collecting plants and animals, keenly observing and carefully recording every aspect of nature.

It was during this period that MacGillivray acquired his great dexterity with the scalpel, and became so accomplished an anatomist that he was appointed dissector to the lecturer on anatomy in Marischal College. Unable, however, to resist the call of natural history, he relinquished this not uncongenial post in order to devote himself exclusively to his mistress. As one of the means to "further his cognition of these things," he set out on foot from Aberdeen for London *via* Fortwilliam and Ben Nevis—hardly the direct route—to visit the British and other Metropolitan museums, and observe life by the way. Drenched or dry, tired or otherwise, he never neglected at the close of the day to record fully in his journal the valuable notes he had made. After an 837 mile tramp, full of extraordinary experiences, he reached the capital, "satisfied," as he says, "with my conduct"; and not unjustly so, for his expedition had gone far to mature the youthful enthusiast. His study of the various zoological collections in London convinced him that the methods of classification of modern ornithologists were such as he could not accept. Before he returned to Aberdeen he had formed the resolve "to become the author of a new system," which formed the aim of his life thenceforward. In 1819 or 1820, MacGillivray migrated from Aberdeen to Edinburgh, and as he had recently married, it

[1] "Life of William MacGillivray, M.A., LL.D., F.R.S.E., Ornithologist Professor of Natural History, Marischal College and University, Aberdeen. By William MacGillivray, W.S. With a Scientific Appreciation by Prof. J. Arthur Thomson. Pp. xv+222. (London: John Murray, 1910.) Price 10s. 6d. net.

became for financial reasons necessary to accept the post of assistant to Prof. Jameson, who then held the chair of natural history in that city. His beloved birds, however, enticed him away again to the fields for a few years, until in 1831 he received the entirely congenial appointment of conservator of the Museum of the College of Surgeons in Edinburgh. Here he accomplished splendid curatorial and research work—among much else replacing, through his accurate knowledge of living nature, the taxidermal monstrosities he found there by lifelike specimens—wherby his great scientific attainments became very widely recognised. His numerous anatomical investigations were continually supplying material for his new system of classification of birds, which, it was his peculiar merit to perceive, should not, as hitherto, be based on their external characters alone, but on their internal organisation as well. He specially devoted his attention to their digestive organs, undoubtedly too exclusively; but still, his was unquestionably a distinct advance on any method previously attempted. At this juncture he became associated as joint author with Audubon, the American ornithologist, in his "Ornithological Biographies."



Nestling Cuckoo being fed by a Meadow-Pipit. From a drawing by W. MacGillivray reproduced in "Life of William MacGillivray."

In this great work all the technical and anatomical descriptions, and even some of the plates, are MacGillivray's, while Audubon's are the drawings and field notes on the species, of which he had an intimate acquaintance. During this period MacGillivray wrote many other books, but he was busy also with his projected "History of British Birds," the first three volumes of which appeared between 1837 and 1840. The wide reputation he had acquired in Edinburgh won for him early in 1841 the natural history chair in Marischal College, Aberdeen. Into his new duties there he entered with all the enthusiasm and energy of his nature, and with the ardent desire—not unrealised—that through his endeavours "the city might obtain a rank among those distinguished for the cultivation of natural history." So strenuously did he labour for eleven years to this end that he found no opportunity until early in 1852 to issue the fourth volume of his great history. It was published during his stay at Torquay, whither he had retreated "from the blasts of the North Sea," in the hope, which proved vain, of recovering his health, "assailed by disease." In July of the same year, within six weeks after the appearance of the concluding volume, this gifted naturalist and most lovable man passed away, amid the esteem of his scientific contemporaries and the special regard and affection of his former pupils, of whom a small remnant only now survives.

The above personal details are summarised from the first five chapters of this welcome "Life," in which all the available information about his distinguished relative has been brought together by a namesake. The succeeding chapter contains a warm appreciation of MacGillivray's scientific work by the present occupant—the fourth in succession—of the Aberdeen chair, Prof. J. Arthur Thomson, himself an ardent naturalist of the MacGillivray type. The final chapter is devoted to a series of delightful and characteristic descriptive passages from MacGillivray's writings, while a selection of his lifelike drawings from those in the British Museum illustrate the volume, one of which, by the courtesy of the publishers, is here reproduced. A volume on the "Natural History of Deeside and Braemar," found in MS. after his death, was purchased and published privately by Queen Victoria. Ornithologists everywhere will echo the regret expressed by Lady Geddes—whose personal recollections of the professor will be read with special interest—that no portrait of MacGillivray is in existence.

It has been peculiarly gratifying to the present writer to have been requested to bring this biography of MacGillivray under the notice of the readers of NATURE. The deepest pleasures of his own life have been derived from natural history pursuits in many parts of the globe, and he may perhaps be permitted to say that his love for nature was awakened in

early childhood by his father, who imbibed his own interest in zoology and botany as a pupil of MacGillivray, and throughout his life never referred to his old professor without some term of affection. The writer, therefore, has always regarded himself as a grandchild of MacGillivray's influence. It was his fortune afterwards to receive in the same class-room his own zoological training, and to engage in curatorial work in the museum in which many of the specimens were labelled in MacGillivray's handwriting, and some years still later to follow closely the track of the *Rattlesnake*, the naturalist of which was John MacGillivray, the professor's eldest son, and its surgeon Huxley, also the writer's revered master. As familiar to the reviewer, too, is MacGillivray's beautiful handwriting—of which a specimen is reproduced on p. 68 of the "Life"—as if it were that of a member of his own family; for, by a strange chance, one of his brothers had the good fortune, while a student, perhaps about 1865, to rescue for a few pence from a butterer's mean uses a large bundle of MacGillivray's journals. Sad to say, only a few pages ran consecutively, but they were perused with something approaching to veneration. These contained, if memory serves, descriptions of some new species of mollusca; notes of excursions, with zoological and botanical observations—pages, perchance, of the second volume of "A Year's Residence and Travels in the Hebrides," which the "Life" records as lost; memoranda on the conduct and concentration of his pupils, while sitting for their class examination; the names tabulated according to "nations" (natal regions), and to harmony and disharmony in colour of their hair and eyes, with the proportion of successes or failures in these categories. Alas! it is to be feared that these pages have now also gone the way of all things.

It is gratifying, especially to Aberdonians, to find MacGillivray's memory so sympathetically revivified in this volume, and to feel that it will be kept green thereby for the future among his successors in the title of ornithologist.

THE MAORIS OF NEW ZEALAND.[1]

MR. JAMES COWAN has done the student as well as the general reader a service in publishing the material he has personally collected from the *kaumatuas*, the old and learned men of many Maori tribes, for the time is rapidly approaching when very little more can be gathered from the natives. The book is by no means of the monographic kind, but consists of what are virtually a series of essays on different subjects, based entirely on first-hand information and the experiences of a lifetime of sympathetic intercourse with the Maoris.

The subject-matter may be grouped as follows:—The origin and migrations of the Maori and the settling of New Zealand; religion, tapu, omens, and the like; social customs, houses, canoes, tattooing; nature lore, folk-tales, poetry; while the last third is mainly devoted to the Maori in war, intertribal and with Europeans, and to cannibalism.

Comparatively early in the book we find it stated "that the Maori-Polynesian is a brand, though a distant one, of the Caucasian race is now generally accepted." It may be granted that the main stock of the Polynesians had, in the remote past, some relationship with the ancestors of certain peoples now living in Europe, but since then mixture has taken place with other races. A few students of Maori and other Oceanic languages have endeavoured to trace them to a Semitic origin, but there is no likeness between the grammar, and Polynesian and Semitic words are made in an absolutely different way, and there is no sort of likeness in the changes they undergo. The so-called evidence of connection is based only on the resemblances of certain words, but this is a method that could be adopted to prove any other theory. It comes therefore as a shock to read, "Certainly there seems to be adequate evidence to justify us in arriving at these general conclusions: that it was on or near the shores of the Persian Gulf and of Arabia that the ancestors of the Maori-Polynesian lived; that they had racial affinities with the ancient Chaldeans, from whom they gained most of their astronomical knowledge; that they also were blood relations of the Phœnicians, who were the most adventurous of ancient mariners; that they had affinity with the Egyptians, some of whose religious traditions they absorbed" (p. 31). "The coastal people of south-western Asia were from ancient times navigators with a knowledge of the stars; they, and probably the early Egyptians, were amongst the earliest sailors"—[what evidence is there that the Egyptians were ever a seafaring people?] "They coasted down the eastern shores of the African continent, at any rate as far as the Zambesi, and they also visited, and probably partly colonised, Madagascar; this would account for the resemblances between the Maori-Polynesian language and the Malagasy" (p. 35).

The sole evidence for this south-westerly migration

The Korotangi. From "The Maoris of New Zealand."

of the ancestors of the Polynesians is the undoubted relationship of Malagasy with Austronesian languages. Malagasy is definitely related to the Indonesian group of languages, especially the Batta of Sumatra, Ngadju Dayak of Borneo, Sangir, and certain Philippine languages (*e.g.* Tagal), which must be regarded as more primitive than the Melanesian languages or the later Polynesian; but there is nothing Semitic about any of them, and we cannot at present profitably trace the Indonesian-Polynesian stock further back than to the supposed "Gangetic Race" of J. H. Logan, a conclusion to which S. Percy Smith evidently subscribes in his valuable little book, "Hawaiki." Mr. Cowan fortunately deals very little with such problematical questions, and we can feel more at ease when he confines himself to purely Maori ethnology.

There is an interesting account of the several voyages of the historic canoes to New Zealand, and an illustration is given of a carved stone bird, the *korotangi*, or "cying dove," which was brought in the Tainui canoe from the ancient home of the race. Mr. Cowan asserts, and we can well believe him, "it is not of Maori manufacture"; it is $10\frac{1}{4}$ inches long, and "carved with high artistic finish out of a very hard and heavy dark-green metallic stone." Of especial value are the numerous translations of Maori invocations, charms, and poems. The chapter on social life is superficial, and tells us nothing about the real social organisation of the people. The account

[1] "The Maoris of New Zealand." By James Cowan. With numerous illustrations from photographs and drawings. Pp. xxiv+356. (Christchurch, N.Z.; London: Whitcombe and Tombs, Ltd., 1910.) Price 15s. net.

of the *whare-whakairo,* or large communal assembly hall, is of considerable interest. The book is well illustrated, and the note on Maori pronunciation is welcome, but an index is lacking. The get-up of the book is a credit to the New Zealand firm which publishes it.

THE ATTITUDE OF DIPLODOCUS.[1]

SINCE Mr. Carnegie gave a plaster cast of the skeleton of Diplodocus to the British Museum in 1905, he has distributed other copies of this remarkable Dinosaur to the museums of Paris, Berlin, Vienna, and Bologna. A large part of an actual skeleton was also given by the late Mr. Morris K. Jessup to the Senckenberg Museum in Frankfurt. A widespread interest has thus been aroused in the gigantic Sauropodous Dinosauria, and there have been many discussions as to their original form and mode of life.

When the late Profs. Marsh and Cope first obtained nearly complete skeletons of these reptiles, they compared the limbs with those of an elephant, and decided that the creatures must have walked in a quadrupedal manner, with the body well raised above the ground. Considering their immense weight, the position of their nostrils on the highest point of the head, and the feebleness of their dentition, which seems to imply a succulent food, the professors were agreed that the animals must have spent much of their life under water. Prof. Cope also supposed that the long neck, which characterises all the Sauropoda, would enable them to reach the surface to breathe while browsing on water-weeds in a considerable depth of water. It is now generally admitted that the theory of their semi-aquatic mode of life is well founded, and it has been observed that the feeble teeth are not placed in close series, but separated by small gaps, as if they formed a strainer for the food which was taken in. Much difference of opinion, however, has arisen as to the attitude of the limbs.

Messrs. Hatcher and Holland, who prepared the cast of Diplodocus, and Prof. H. F. Osborn, who mounted a skeleton of Brontosaurus in the American Museum at New York, followed Marsh and Cope in arranging the limbs for a quadrupedal walking gait. Dr. O. P. Hay, of Washington, on the other hand, subsequently maintained that the limbs must have been bent, like those of a crocodile, for crawling, and last year Mr. Gustav Tornier, of Berlin, elaborated this theory, publishing a somewhat fantastic sketch of the skeleton as he would arrange it. Prof. O. Abel, of Vienna, has now prepared an interesting summary of all these discussions, and finally concludes that the attitude of Diplodocus and its allies, with which the restorations have made us familiar, is really the correct one.

Prof. Abel begins his paper by deploring the fact that most museums restore the skeletons of extinct animals, partly by hypothetical plaster-work, partly by using the bones of more than one individual, without any clear explanation on the labels. He has, therefore, taken the trouble to state exactly the nature of the materials from which the well-known cast of *Diplodocus carnegii* was made, and he has no serious fault to find with its general composition. It is possible that two or three vertebræ are lacking, and part of the tail may not be sufficiently stout, otherwise there is little to criticise. He thinks that the axis of the head is in direct line with that of the neck; as usual in reptiles, and that the browsing attitude is due to the natural curvature of the end of the neck. He points to the deeply ovate cross-section of the trunk as showing that it is not adapted for crawling along the ground, but must have been lifted during locomotion. He then discusses the structure of the feet in detail, and demonstrates that they are digitigrade, the fore feet more so than the hind feet. As in Iguanodon (of which footprints show the impressions) there must have been elastic pads beneath the toes, and most of the weight of the body seems to have been supported by those below the reduced outer toes. The structure of the digitigrade feet necessitates nearly upright limbs, which would support the trunk and give the reptile a true walking gait. There would be a slight outward bend of the elbow, but otherwise no sprawling attitude. The Sauropoda, therefore, form no exception to the rule, that the extinct Dinosaurs resembled mammals and birds in their habits and movements.

[1] "Die Rekonstruktion des Diplodocus." By O. Abel. Abhand'. k.k. zool.-botan. Ges. in Wien. Bd. v., Heft 3. Pp. 60+Tafel 3. (Jena: G. Fischer, 1910.) Price 2.40 marks.

THE PROTECTION OF NATURE.[1]

"IT is the first time a very comprehensive attempt has been made to do important public service of this character on purely non-partisan lines. . . . It is indeed a great work. We have here the first Commission of the kind ever established by a National Government. . . ." Thus the Hon. Clifford Sifton, chairman of the Commission for the Conservation of the Natural Resources of Canada, at the conclusion of the Commission's first annual meeting, held in January of this year.

The establishment of this Commission is a noteworthy departure, and is actually a method of insuring the future prosperity of the country. Canada is peculiarly amenable to such a step, as large areas of her land are in the hands of the Government, and also peculiarly in need of it. The latter point is obvious when it is remembered that owners of timber property are only just beginning to assimilate the idea of afforestation, that lumbermen are constitutionally destructive, and that forest fires are not an occasional catastrophe, but seasonally recurring and accepted phenomena. In England we hardly realise this last fact, or the destruction produced by a forest fire. The following statement gives a glimpse of the reality:—"The spring fires are not, as a rule, so dangerous to the forests, as they are what we call leaf fires, while the fall fires are soil fires. The leaf fire will run through the woods, and while it destroys a lot of timber, it does not have the same effect as a fire in the fall, because that not only takes the leaves and wood, but it takes the soil as well, and *burns down five feet, so that for a thousand years nothing will grow on that land.*" (My italics.) It appears that railway locomotives cause the majority of these devastating conflagrations.

Destruction without perpetuation has been carried on in other departments. "In the Yukon there are," says Mr. Congdon, "hundreds of square miles where I do not think you could now find a single fur-bearing

[1] First Annual Report of the Commission of Conservation, Canada. By courtesy of the High Commissioner for Canada, 17 Victoria Street, London. (Ottawa: The Mortimer Co., 1910.)

Mitteilungen des Provinzialkomitees für Naturdenkmalpflege. Schleswig-Holsteinischen, No. 1 (1909); Pommerschen, No. 2 (1910); Sächsischen, No. 1 (1908); Westpreussischen, Nos. 1, 2, 3 (1908–10); und des Bezirkskomitees Regierungsbezirk Sigmaringen, No 1 (1909); Cassel und Waldeck, Nos. 1, 2 (1908–9)

Naturdenkmalpflege und Aquarienkunde. By R. Hermann and W. Wolterstorff. (Brunswick, 1909.)

Naturdenkmalpflege. By Prof. Gürich. (Sonderabdruck aus der Zeitschrift der Landwirtschaftskammer für die Provinz Schlesien, 1909.)

Über Zeil u. Methode der Naturdenkmalpflege. By Prof. Dr. B. Schaefer-Cassel. (Schmalkalden, 1909.)

Über das Tierleben in dem von der Staatsforstverwaltung geschützten Zwergbirken-Moor in Neulinum. By Dr. Th. Kuhlgatz. (Sonderahdruck aus dem 32, Bericht des Westpreussischen Botanisch-Zoologischen Vereins, Danzig, 1910)

Neues aus der Naturdenkmalpflege. By Dr. W. Günther. (Naturwissenschaftliche Wochenschrift, August 7, 1910; Jena.)

animal. They have been absolutely exterminated by hunting; trapping, or by the decrease of the food-supply which occurred in the years 1904-5." An interesting cause is the disappearance of the rabbit. In 1904-5 "some disease smote the rabbits, and they died off by thousands." "In consequence of their disappearance, the animals which fed on them—the fox (the wolf, which need not be counted), the marten, the chief food of which, however, is mice, and other animals—died from absolutely no other cause than starvation." The problem of the conservation of the water supply is curiously bound up with afforestation. For instance, it has been found necessary to conserve the timber on the east slopes of the Rockies in order to conserve the river-heads. "It was shown that the destruction of the timber meant the disappearance of the regular water supply of those provinces, the agricultural production of which is the pride and the hope of Canada."

A list of the committees shows the scope of the Commission. They are seven in number, viz.:—Fisheries, game, and fur-bearing animals; forests; lands; minerals; waters and water powers; public health; press and cooperating organisations. Their reports on the first year's work, the chairman's speech, and the discussions are of unusual interest. Recommendations to Government have already commenced. Such a scheme for the scientific control of the ultimate natural resources of a country must inevitably be adopted elsewhere.

It has, however, one serious deficiency as yet, the absence of any organisation for the preservation of those sites and objects that have no commercial value, but the scientific and artistic importance of which is very great. Such conservation could easily be worked in with the main business. The latest reports of the committees for this special purpose in Germany are to hand. There are official directions giving the least injurious method of picking flowers. Every district seems to be thoroughly looked after and studied by its committee. There are very interesting maps of the habitats of rare plants, and studies of typical fauna, such as that by Dr. Kuhlgatz, on the animal life of the moors in Neulinum. Reference to maps shows that the districts preserved are remarkably numerous. The movement is not merely governmental, but aims at enlisting the sympathetic cooperation of the people. The propaganda is now being extended to the schools, and Prof. Schaefer-Cassel has an eloquent address on the subject. Cases for the "pillory" are recorded, as, for instance, that of a man who in a few years annexed 900 specimens of *Cypripedium calceolus*. This flower, once found near Settle, in Yorkshire, and perhaps in one or two other sites, has now, I understand, disappeared from this country. The same fate will attend many a rare plant, butterfly, or bird, unless we, too, adopt some system of preservation. The *Wild Birds' Protection Act*, it is to be feared, is a dead-letter.

If we had a national commission for the protection of all "monuments of nature," including beauty spots, places interesting for historic or geological reasons, woods, valleys, and hills remarkable for some species of plant, animal, or insect, we should not be a "nation of shopkeepers." But is the United Kingdom too far exploited for a commission for the protection of its natural resources, including its natural history? There would be difficulties in the way, but surmountable difficulties. One very obvious fact presents itself at once—these places of beauty, these habitats of species (by no means useless for the ends of commerce, since they subserve the ends of science), are precisely those which defy culture and would never make it worth while. To make them into natural museums would be a work for which future generations would be more grateful than we can realise. The museum of brick and stone has its uses; zoos and botanical gardens are of no little value; but neither can compare, either for interest or for scientific study, with a reservation. Not only Germany, but Australia, is setting an example here. Dr. Conwentz's book, recently published in England, and an excellent article by Dr. Günther in the *Naturwissenschaftliche Wochenschrift* of August 7 last, give a luminous exposition of the principle and its results.

In time perhaps the world will be full of such spots, where nature may have her Sabbaths and preserve her most interesting children, among whom, last but not least, will be aboriginal varieties of man himself. Is there not a reservation for the tribes of Central Australia?

A. E. CRAWLEY.

AGRICULTURE IN THE DRY REGIONS OF THE BRITISH EMPIRE.[1]

THE ordinary farm crops on which the supply of food-stuffs depends seem to be produced best in regions where the rainfall varies between 20 and 35 inches per annum. Where the upper limit is exceeded in the British Islands, a good deal of pasture is found; on the other hand it is notable that the great wheat-producing districts, the eastern counties, are regions where the rainfall comes nearer to the lower limit. Special agricultural methods become necessary where there is less than 20 inches of rain, as is the case over large areas in Canada, Australia, India and South Africa. These methods fall into two groups: irrigation is required if there is less than 10 inches of rain, while special cultural operations, collectively known as "dry farming," are used when there is as much as 15 or more inches. Between 10 to 15 inches, sometimes the one and sometimes the other method proves the more economical.

"Dry-farming" methods are of great interest to the student of soil physics. Their object is to keep the rain water near the surface of the soil and to prevent loss by evaporation, by surface drainage, and, if possible, by percolation. A remarkable degree of success appears to be attained. An examination of the methods in vogue in different parts of the world shows that all have certain features in common. The land is ploughed up in a rough state and the subsoil compacted directly after harvest or before the rainy season, if there is one; in countries where the rain is unevenly distributed and torrential downpours occur, rather elaborate terracing is arranged to prevent any loss by running off the surface; any streams that form having to follow a sinuous course over the whole field, so that absorption may be as complete as possible. Directly the rain is over, the surface soil is thoroughly stirred, thereby losing a little water by evaporation, but forming a loose layer. The water is thus imprisoned between the compacted subsoil and the thin loose layer of surface soil. The greatest importance is everywhere attached to the maintenance of this loose layer on the top; cultivation is repeated as often as rain has fallen, or whenever for any other reason it is considered the layer has become compact. Incidentally this repeated cultivation has the effect of keeping down weeds, which, if unchecked, would use up a good deal of the water.

In the dry parts of Canada and the United States, where these methods are most highly developed, it is customary to take a crop—usually wheat—once in two years only, leaving the land fallow in the alternate year. It is considered that two-thirds or even more

[1] *Transvaal Agricultural Journal*, vol. viii., 1910.
Agricultural Journal of the Cape of Good Hope, vol. xxxvi., 1910.
"Water Requirements of Crops in India." By J. W. Leather. (Memoirs of the Department of Agriculture in India.)

of the year's rainfall may, under favourable conditions, be stored in the soil for the next year; thus, if only 15 inches fell each year, making a total of 30 inches in the two years, the wheat crop grown during the second year should have moisture available equivalent to 25 inches or more, on which, of course, it should do very well. Unfortunately, the rainfall does not necessarily remain near its average, but fluctuates considerably, and records are not available for many districts; it has occurred in districts where dry farming was considered a great success that the rainfall was, after all, about 20 inches, and ordinary cultivation would have been equally good.

However, the interesting problem is this: What is function of the compact subsoil and the loose surface layer? It is usual to suppose that the compactness of the subsoil facilitates the upward lift by surface tension of water from the permanent water table, but it would seem equally rational to suppose that the compact subsoil retards the percolation of the water. So far as the writer is aware, no crucial experiments have been made that show beyond doubt how far the upward movement of water by surface tension is a factor in ministering to the needs of the plant. That it takes place, of course, is not disputed, but its relative importance is unknown. The function of the loose layer on top, the "mulch," is not settled. It is commonly regarded as a break in the structure of the soil leading to a rupture of the "capillary films" of water. It may equally be a non-conducting layer shielding the mass of the soil from the sun's heat, and therefore lessening evaporation.

Until these problems are solved, little advance can be expected from the scientific point of view, although the practical man continues to effect improvements. The fundamental need seems to be a mathematical analysis showing how water will distribute itself over a mass of particles varying in diameter from below 0·002 mm. up to 0·1 mm., the bulk being below 0·01 mm., and how rapidly any disturbance in equilibrium will readjust itself. The pressing need of work in this direction may be gauged from a perusal of the Transvaal, the Cape, or the South Australian Agricultural Journals; in South Africa alone a considerable part of Cape Colony, the western halves of the Orange Free State and the Transvaal, the whole of the Bechuanaland Protectorate and a considerable portion of southern Rhodesia fall within the "dry lands" area. Some useful practical work may be expected from the newly established dry-land experiment station, but that will only intensify the necessity for a scientific study of the problem.

There is also need of work by the plant physiologist on the effect of insufficient water supply on plant growth. In Dr. Leather's paper data are given showing how much water is transpired by a plant in the production of one pound of dry matter, and on the basis of these figures a table is made out showing how much irrigation or rain water is needed to obtain crops of certain sizes. The values depend on the amount of food-stuff available; less water is needed per pound of dry matter produced in a rich soil than in a poor one. Although there is no direct causal relationship between transpiration and assimilation, the ratios obtained by different observers in various parts of the world are roughly of the same order; thus for barley the number of pounds of water transpired per pound of dry matter produced are:—

Lawes and Gilbert (Rothamsted, 1850)	257
Wollny	774
King (Wisconsin, 1894)	393
Leather (Pusa, 1910) on manured soil	480
,, ,, on unmanured soil	680

E. J. RUSSELL.

THE CAVENDISH LABORATORY.

THERE is no more pleasant way of spending a week-end than by re-visiting the University Town of Cambridge in term time to meet the old friends and comrades of years gone by, and it was a happy thought that induced the writer of the "History of the Cavendish Laboratory" to choose a Saturday for presenting an edition de luxe of the book to the Cavendish Professor of Experimental Physics.

Saturday, November 12, was a red letter day for all who are interested in the Cavendish Laboratory, for it was the occasion of the assembling of a number of distinguished persons to do honour to the "boy professor" of a quarter of a century ago, who has so amply justified the confidence of the Board of electors in appointing so young a man to a post of such importance. Clerk Maxwell and Rayleigh were not easy men to follow; the standard they had set was a high one, the Cavendish Laboratory had become a prominent institution dependent for maintaining its position and for its further development not only on the scientific reputation of its Director, but on his power to attract the ablest young men of the day.

How far Sir J. J. Thomson has done this was evidenced by the number of distinguished visitors to Saturday's ceremony, among whom we noted: Lady Thomson and her little daughter Joan, Mrs. Sidgwick, the Vice-Chancellor, the Bishop of Ely, the President of Queens' and many Masters of Colleges, Sir T. Clifford Allbutt, Sir Robert Ball, Profs. P. V. Bevan, R. H. Biffen, F. C. Burkitt, Sir George Darwin, Prof. Ewing, Dr. Wm. Garnett, Profs. W. M. Hicks, F. G. Hopkins, B. Hopkinson, Dr. J. N. Keynes, Sir Joseph Larmor, Profs. Liveing, Leahy, Alexander Macalister, Dr. J. E. Marr, Profs. H. F. Newall, W. J. Pope, J. H. Poynting, E. Rutherford, Dr. J. E. Sandys, Mr. Sidney Skinner, the Hon. R. J. Strutt, Mr. H. M. Taylor, Mr. W. C. D. Whetham, Prof L. R. Wilberforce, Mr. C. T. R. Wilson, Prof. G. Sims Woodhead, and Prof. A. M. Worthington.

In the unavoidable absence of the Chancellor, the Vice-Chancellor presided, and declared his position a sinecure in that the speakers needed no introduction.

Dr. Glazebrook, in making the presentation, began by reading a message, contained in a letter to himself, from Lord Rayleigh, Chancellor of the University:—

My interest in the Cavendish Laboratory began with—indeed preceded—its inception, and I had the privilege of the acquaintance of that great genius, the first professor, on whom fell, of course, a vast amount of work in connection with the building and equipment. The laboratory had hardly more than got to work when British science sustained an irreparable loss by the death of Maxwell. My interest then became a responsibility. During the five years from 1879 to 1884 the educational work was greatly developed under yourself and Dr. Shaw, and in research some good work was done. But I must not dwell upon what, no doubt, most of the present students look upon as the dark ages. For six-and-twenty years Sir Joseph Thomson has had the direction, and under him the Cavendish Laboratory has assumed the first place among physical laboratories. By his own researches, pursued with astonishing ardour and success, he has opened up a new world, and, what is in some respects a task even more difficult, he has inspired and trained a number of followers, among whom I am pleased to reckon my own son. Cambridge has every right to be proud of the Cavendish Laboratory, its professor, and his staff.

I will ask you to convey my congratulations to Sir J. J. Thomson. For the future one can wish nothing better than that it should resemble the past.

Dr. Glazebrook, continuing, briefly sketched the history of the Laboratory as contained in the book, which he said was written by men who took part in the events they described.

The book has been written partly in the hope of enabling educated Englishmen who are not physicists to understand the meaning of the work done at the Cavendish Laboratory. . . . It covers a wide range of intellectual qualification from that of the M.B. student to that of the brilliant band Rutherford, Wilson, Townsend, McLellan, Langevin, Richardson, Zeleny, and the others who were research students ten years ago. The Master of Trinity in an eloquent speech a few months ago told his audience he was a dreamer of dreams, and in one dream he pictured a larger university with its portals opened wide and men of many nations and kindred flocking in from all lands to reap the rich harvest of ancient learning or modern science which only Cambridge can furnish, and to carry back to their distant homes the garnered sheaves to feed and fertilise the world. Sir J. J. Thomson has realised such a dream. The new regulations for advanced students passed in 1895 were accepted in large measure through his advocacy, and since that time an ever-increasing stream of men coming from every land has been directed towards Cambridge; the list of those who have carried on researches in the Cavendish Laboratory during the last forty years contains some 250 names; the list of published memoirs covers forty pages. Former students hold important posts in almost every great university; the fact that of the professorships of physics in the colleges of university rank in England all but one are held by Cambridge men shows the wide influence of the laboratory at home. Go where you will, not only in English-speaking lands, to any centre of physical study and you will find one or more who is proud to say he was a research student of the Cavendish Laboratory and a pupil of Sir J. J. Thomson.

As representing those pupils and in the name of the large assembly here present, in the name of the scientific world, I am here to express to you our high appreciation of the services you have rendered to science and to the University, to assure you of the affectionate regard for you personally of all your pupils, and to wish for you and Lady Thomson many years of fruitful activity and continued happiness. Can I do better than repeat the Chancellor's wish—that the future may resemble the past?

It is my privilege to ask you to accept this volume with its record of your great work as some slight recognition of all you have done.

Sir J. J. Thomson responded in a characteristic speech. There was no mention of his own work further than the expression of the wish, which raised a smile on all faces, that he had done more. His speech was an acknowledgment of all he owed to his College, his University, and those personal friends from whom, he said, he had received help without which there would have been no such celebration. He referred to the triumvirate Rutherford, McLellan, and Langevin, and mentioned that one of them had received the Nobel prize. No one was forgotten in the expression his thanks; the demonstrators, the students, the assistants in the Laboratory, were all remembered and many of them mentioned by name. To everyone full appreciation was accorded, and the one person not mentioned, whose work and influence were not alluded to, was the Director of the Laboratory, the Professor to whom all else was due.

The Vice-Chancellor briefly declared the proceedings ended, and passed, "as a business man," to the next item of the agenda, "Cavendish Laboratory Afternoon Tea," an institution of Sir J. J. Thomson, which has accompanied Cambridge Physicists to all parts of the world and, conversation becoming general, the afternoon ended most pleasantly.

S. J. D. S.

MR. W. R. FISHER.

As announced with regret last week, Mr. W. R. Fisher, assistant professor of forestry at Oxford, died on November 13, after an operation. He had not been in good health for some time past, but his death occurred rather suddenly.

Mr. Fisher was born in 1846, at Sydney, New South Wales, where his father was Crown Solicitor, but became afterwards the first Attorney-General of New Zealand. He came to England quite young, and was educated at Cambridge, the home of his father and grandfather, the latter having been a banker in Petty Cury. He joined St. John's College, and took his degree in 1867, being placed 17 senior optime. Soon afterwards he became a mathematical master at Repton School.

In 1869 Mr. Fisher competed for an appointment in the Indian Forest Service, being bracketed first. After the necessary training in forestry, chiefly at Nancy, and partly in Scotland, he joined the Bengal Forest Department in 1872. On the establishment of the Assam Chief Commissionership, in 1874, he was transferred to that administration and remained there until 1878. During that time he started the Charduar Rubber Plantation (*Ficus elastica*), which was extended to an area of about 1000 acres. Mr. Fisher was thus one of the pioneers of artificial rubber plantations. In 1878 he was specially selected for the appointment of deputy-director of the newly-established School of Forestry at Dehra Dun, and he rose subsequently to become the director of the school and conservator of forests of the school circle.

In the year 1889 he came home on furlough, and in 1890 he joined the staff of the School of Forestry at Coopers Hill College. In the year 1905 he went with that school to Oxford, where he became a member of Brasenose College.

Mr. Fisher has left his mark upon forest science and practice. At Dehra Dun he taught chiefly forest botany, and he brought out a volume on plant physiology. After he joined at Coopers Hill, he taught silviculture, forest protection, and utilisation. He joined Sir W. Schlich in bringing out the latter's "Manual of Forestry," of which he undertook the preparation of vol. iv. on "Forest Protection," and of vol. v., on "Forest Utilisation," now in their second edition. Although these two volumes are adaptations of Hess's work on protection and Gayers's book on utilisation, Fisher's books are more than the original works, since he adapted the material to British and Indian conditions. They may be considered the standard works on the two subjects.

Throughout his life Fisher was an active writer, and it would be difficult even to enumerate the many articles on forestry which he published. He was an active member, and president for two years, of the Royal English Arboricultural Society, and editor of the society's *Journal*. After his arrival at Oxford, he started an arboretum of indigenous and exotic trees on land belonging to Magdalen College.

During his leisure time he advised many British proprietors on the management of their woods, and thus helped forward the question of forestry and afforestation in these islands. He was, in 1907, a member of the Departmental Committee of the Board of Agriculture in Ireland on afforestation, and lately of the committee sitting in London, dealing with agricultural and forestal education in Britain.

Mr. Fisher was a man of very simple character, with a warm heart, and he was universally liked, not only by the students, but also by a large host of friends. He conducted the annual excursion to France, and it was quite touching to see how French

forest officers and subordinates admired and honoured him.

He married, in 1876, Mary, eldest daughter of the late Dr. Briscoe, civil surgeon of Cooch Behar, in Bengal, and leaves one son, a lieutenant in a Ghurka regiment, and two daughters. By his death the Empire loses an enthusiastic forester, who can ill be spared at the present time.

NOTES.

We regret to see the announcement of the death on November 11, at sixty-two years of age, of Prof. Jules Tannery, the distinguished French mathematician.

Councillor Wiehl has just bequeathed, says the *Revue scientifique*, the whole of his fortune, of about a million crowns, to the Bohemian Academy of Sciences at Prague to encourage scientific and technical research.

A short time ago it was suggested that the Eiffel Tower should be used as a station for the daily transmission of time-signals to ocean-going vessels by means of wireless telegraphy. The Paris correspondent of the *Times* reports that this service was inaugurated on November 21 with satisfactory results. In future, time-signals will be sent out twice daily, at 11 a.m. and 12 midnight. Three signals will be made on each occasion at two-minute intervals. The morning transmission will not, however, take place on Sundays and holidays.

The Earl of Stair has accepted the presidency of the Royal Scottish Geographical Society in succession to Prof. James Geikie, F.R.S., who has held the office of president for the last six years. The anniversary meeting of the society was held on November 11, and was addressed by Sir John Murray, K.C.B., F.R.S., who chose for his subject "The Deep Sea." Before the address Prof. Geikie was presented with the society's gold medal in recognition of his distinguished services to geographical science, and Sir John Murray with the Livingstone medal in recognition, not merely of his prolonged and valuable oceanographical research, but also in commemoration of the completion of the great national work "The Bathymetrical Survey of the Fresh-water Lochs of Scotland."

In the interests of precision in scientific diction, a correspondent asks that the familiar expression "thunder and lightning" should be inverted in accordance with the natural sequence of cause and effect, and become "lightning and thunder." He adds:—"I never could grasp how the confusion originated, considering that, in agreement with the transmission of light and sound, the flash is seen before the thunder is heard."

The eighty-fifth Christmas course of experimentally illustrated lectures adapted to a juvenile auditory, to be given at the Royal Institution by Prof. Silvanus P. Thompson, F.R.S., promises to be of exceptional interest. The subject is "Sound, Musical and Non-musical." The dates and subjects of individual lectures are:—1910, December 29, production of sound; December 31, transmission of sound; 1911, January 3, reception of sound; January 5, combination of sounds; January 7, registration of sounds; January 10, reproduction of sound.

At a meeting of the executive committee of the British Science Guild, held on November 16, on the motion of Mr. A. Moseley, C.M.G., it was decided to form a special combined education committee to deal, in the first instance, with education of the governing classes of England. It was resolved to defer the circulation of the synchronisation report until a later date. It was decided to consider further the reduction of the rate of postage on scientific literature. It was also suggested that the annual meeting should in future be held in the month of April, and that the annual dinner should, if convenient, be held on the same day.

We regret to announce the death, at sea, at the age of thirty-one, of Mr. Richard Froude Tucker, Archæological Surveyor of the Northern Circle, India. Mr. Tucker held the post of curator of the Delhi Museum, and the catalogue of the archæological collections deposited there was recently prepared by him in collaboration with Dr. J. Ph. Vogel. Appended to this catalogue is a memoir by Mr. Tucker on the elephant statues at the Delhi Gate of the Delhi Fort. The untimely death of this promising archæologist is a severe loss to antiquarian research in India.

During the summer of this year excavations were carried on, under the superintendence of Dr. Felix Oswald, at the site of the Roman station of Margidunum on the Fosse Way, midway between Leicester and Lincoln. Some local pottery, Samian ware, coins of Victorinus, Carausius, Constans, and Eugenius, dated between 265 and 395 A.D., have been discovered. The main feature of the finds was the relative abundance of iron objects, such as swords, knives, a bolt of a spring-lock, rings, and nails. A skeleton of an old man and three infants was associated with bones of the Celtic ox (*Bos longifrons*) and other domesticated animals. These antiquities have been deposited in the museum at Nottingham Castle, where it is hoped they may form the nucleus of a Romano-British section.

The Rome correspondent of the *Times* announces that a decree was published on November 20 creating a commission to examine the view that pellagra is produced by a protozoal infection conveyed by an insect, and to formulate any changes in the existing law of protection that may be considered desirable. The commission consists of nine members, all doctors with the exception of Prince Teano, deputy, who was chiefly instrumental in directing the attention of the Italian Government to the work of the English Pellagra Investigation Committee. An article upon the investigations made by Dr. Sambon for this committee appeared in Nature of October 27.

On November 12 an extension of the natural history section of the Hull Public Museums was opened by Mr. T. S. Taylor, Mayor of Hull. In the ornithological section of the museum there is an unusually extensive collection of British birds. The extension consists of three large rooms, the largest of which is occupied by a collection of British birds containing more than 900 specimens. In the second room is a collection of local mammals, including the group of otters, badgers, stoats, weasels, and so on. The third room contains a collection of skeletons—animals and birds. The museum is fortunate in having been presented with the collection of birds formed by the late Sir Henry Boynton. This collection consists of about 200 cases containing 450 birds.

Attention has already been directed in Nature to the scheme of the British Empire League for the erection in London of a memorial to Captain Cook. We are glad to notice that the secretaries of the Royal Society have written to Lord Brassey, the honorary treasurer of the fund, expressing, on behalf of the Royal Society, approval of the scheme, and enclosing a subscription of twenty-five guineas from the society. Their letter includes the following paragraph:—"We are instructed to express the gratification of the Royal Society that public opinion has at

length taken form in this direction, to the extent that there is now a prospect of a memorial which shall be not inadequate to the merits and renown of this great explorer. As the circular issued by your committee states, the Royal Society was closely connected with the initiation of these famous voyages, with the selection of Captain Cook to the command, and with the working up and publication of the results of the expeditions. Many of its Fellows, including Sir Joseph Banks, one of Cook's companions in his first voyage, afterwards for many years president of the Royal Society, took a prominent part in that work; and the society still retains in its possession memorials of this connection."

UNDER the heading "Earthquakes in the Pacific," the *Times* of November 17 published a statement by Mr. J. J. Shaw, of West Bromwich, that there was evidence the ocean depths of the Pacific are in a state of great unrest. Mr. Shaw said that his seismograph recorded shocks at 8 a.m. on Monday, November 14, and at midnight and between 2 and 3 p.m. on Tuesday, November 15, all at a great distance. In reply to an inquiry as to these reported disturbances, Prof. Milne has sent us from Shide the following records of earthquakes in October and November:—"Although a few small earthquakes were recorded in October, the month was one of earth rest. During the first two weeks of November seismic activity was somewhat pronounced. The dates on which records were obtained, followed by the times of commencement and maximum movement in hours and minutes, were as follows:—November 6, 19.18 and 21.23; November 9, 6.16 and 7.50 or 8.5; November 14, 7.35 and 8.34; November 14, 19.58 and 20.27; November 15, 0.31 and 10.45, 6.1 and 6.21, 7.42 and 7.46, 9.16 a maximum, and, lastly, 14.35 and 15.21. The second of these was the largest, having an amplitude of 7 mm., which means that tiltings of 2·2″ occurred. The time employed is G.M.T. civil, or midnight = 0 or 24h."

AT the first Optical Convention, held in 1905, a permanent committee was appointed, to which was entrusted the task of deciding upon a suitable date for the holding of a second convention, and of taking the necessary steps to initiate it. A general meeting of the committee and of members of the optical industry, representatives of optical bodies and societies, and others interested in optical questions, will be held on Tuesday, November 29, to consider and discuss proposals for the organisation of a second convention. The chair will be taken by Dr. R. T. Glazebrook, C.B., F.R.S., director of the National Physical Laboratory, as chairman of the permanent committee, and all interested are invited to be present at the meeting. The main features of the scheme which the members of the existing executive committee have in view, and the principal questions on which it seems necessary, at this general meeting, specially to invite discussion, are in broad outlines as follows:—(1) an exhibition of optical and allied instruments; (2) the preparation of a catalogue of optical and allied instruments of British manufacture to serve as a convenient work of reference for all users of optical and scientific instruments, not necessarily to be limited to instruments actually exhibited; (3) the holding of meetings for the reading of papers and for discussions and demonstrations on optical subjects; (4) the publication of a volume of Proceedings, in which these papers will be collected together.

WE regret to see the announcement of the death, on November 16, of Dr. J. F. Payne, emeritus librarian to the Royal College of Physicians, and the author of valuable medical works and many other contributions to science. From an obituary notice in the *Times* we learn that Dr. Payne was born on January 10, 1840, and took his degree at Oxford in 1862 with first-class honours in natural science. In 1863 he obtained the Burdett-Coutts scholarship in geology, and in 1865 the Radcliffe travelling scholarship. In accordance with the regulations of the Radcliffe scholarship he went abroad, spending some time in Paris and in Berlin, and proceeding later to Vienna. On his return to this country Dr. Payne was appointed examiner in natural science at Oxford, demonstrator of morbid anatomy and curator of the museum to St. Mary's Hospital. It was about this time that he revised, enlarged, and edited Jones and Sieveking's "Manual of Pathology." In 1871 he went to St. Thomas's Hospital, being appointed lecturer successively in general pathology, materia medica, forensic medicine, and finally on the principles and practice of medicine. About nine years ago he was appointed consulting physician to this hospital. In 1873 Dr. Payne was appointed to deliver the Gulstonian lecture of the Royal College of Physicians, and in later years he gave the Lumleian and the FitzPatrick lectures. In 1879, when the plague was prevalent in Russia, and the college was consulted by the British Government, they appointed Dr. Payne to accompany Surgeon-Major Colvill as commissioners to investigate and report on the disease. He became a Fellow of the Pathological Society in 1869, and was afterwards a councillor, a member of the morbid growth committee, secretary from 1880–2, vice-president from 1888–9, and president in 1897. He was twice president of the Epidemiological Society, choosing for his first inaugural address the subject of "Tuberculosis as an Endemic Disease," and on the second occasion "The History of Epidemiology in England." He was also president of the Dermatological Society, and was vice-president of the Royal Medical and Chirurgical Society in 1906. Dr. Payne was the author of "A Manual of Pathological Anatomy" and "Observations on some Rare Diseases of the Skin," and the life of Thomas Sydenham in the "Masters of Medicine" series.

THE Eugenics Education Society has distributed a special "Poor Law number" of the *Eugenics Review*, which is devoted to the eugenic aspect of Poor Law reform. The number contains a report of a committee of the society appointed to consider the reform of the Poor Law from this particular point of view; reviews by Dr. C. S. Loch and Mr. Sidney Webb, respectively, of the majority and minority reports of the Poor Law Commission; and a most valuable article, by Mr. E. J. Lidbetter, the General Relieving Officer of the Bethnal Green Union, on some examples of Poor Law eugenics. Of the report of the committee, the third section is the most important. Through the kindness of various boards of guardians, the committee has been allowed access to workhouse records, and, where necessary, personal interviews with paupers; three extensive pedigrees of pauperised families are in course of construction, and the most complete of these is now published, the chart being supplemented by a key giving detailed particulars of the cases included. The chart covers five generations, and indicates the intermarriage of five pauper families. Mr. Lidbetter's investigation supplements this report of the committee by some thirteen charts of pedigrees based on his personal investigation. The society and Mr. Lidbetter deserve unreserved commendation for carrying out such researches, which must have required much prolonged and laborious work. It is no reflection on the work if we add that it still remains a most difficult problem to determine, on the

basis of such data, the relative parts played by heredity in the strict sense of the term, continuity of environment, and example. We gather from an accompanying letter that the society finds it impossible, from lack of funds, to proceed with such investigations on any sufficient scale, and urges the formation of a Departmental Committee with power to examine records.

AT the recent conversazione of the Geologists' Association, held at University College, Gower Street, a series of worked flints from the Ipswich district was exhibited. The circumstances in which they were unearthed indicate that they are probably the oldest works of man yet discovered in this country. They are well chipped, deep brown and cream in colour, and several show scratches which may be the glacial striæ imprinted when they formed part of the gravel at the base of a glacier. Technically speaking, they are of pre-Crag age, that is to say, they long precede the Glacial period. Mr. W. Whitaker, F.R.S., who mapped the district for the Geological Survey, is satisfied that they come from undisturbed beds, and that the gravel from which the flints were obtained is of pre-Crag Age. This discovery, if it stands the criticism to which it will certainly be exposed, marks a memorable advance in the prehistoric anthropology of this country.

IN the October issue of *Man* Mr. D. Alexander gives an account of a performance of a Nigerian Punch and Judy show, which in some ways resembles the drama which is familiar to us. A forked stick is thrust into the ground, the performer kneels, and, taking off his black gown, throws it over the stick, the opening for the head of the wearer serving to provide a space for the display and withdrawal of the figures. The conversation between the puppets is carried on, as in the European performance, in a squeaky tone. The place of origin of this play is somewhat uncertain, but there seems to be no doubt that it is an indigenous invention. In the same issue of *Man* Captain A. J. N. Tremearne discusses the system of bull-fighting among the Fulani, a race of cattle breeders in northern Nigeria, who seem to be of Berber origin. In contrast to the conditions of the sport in Spain or Portugal, the Nigerian variety is comparatively tame, no horses being used, the performers being unarmed, and the bulls escaping any kind of injury.

To the *Irish Naturalist* for November Dr. Scharff communicates an article on the whale-fishery which has been carried on by Norwegians during the last three years at Inishkea, and for a rather shorter period at Ely Point, on the Mayo coast. At the former station 124 whales have been taken during the last two seasons, most of these being rorquals, although five black right-whales, of an estimated value of between 1500*l.* and 3000*l.*, were captured in 1908. A single blade of the whalebone of this species is worth about two guineas, and the total yield of this substance may be as much as a quarter of a ton, with a value of about 400*l.*

IN a pamphlet on the distribution and migration of North American shore-birds, issued by the U.S. Department of Agriculture as Bulletin No. 35, Mr. W. W. Cooke emphasises the economic importance of this group. For many years the abundance of larger birds, such as swans, geese, and ducks, caused the waders to be neglected, but with the killing off of the former gunners directed their attention to the latter, which now stand in need of immediate protection. In addition to their value as food, the plovers and some others do valuable service as destroyers of noxious insects, while all the members of the group are of special interest from an æsthetic point of view. Details of the distribution and migrations of the various species form the bulk of the pamphlet.

IN the October issue of the *Irish Naturalist* Mr. A. Williams directs attention to the presence of sanderlings during the last three years on the shores of Dublin Bay throughout July, a month when these birds are generally supposed to be residing in the far north for the purpose of breeding. These July birds are evidently non-breeders—either old or barren—but it has yet to be determined whether they remained in Ireland when the bulk of their kind winged their way northwards, or whether they were the first of the main body to return south. During their sojourn in Ireland these non-breeders undergo a considerable change in plumage. "They have been found with the red colouring entirely absent, and also the soft grey margins of the feathers, which conceal the nuptial plumage in spring, completely worn away, and in some instances the ruddy coloration faded out, causing the birds to present a totally changed and misleading appearance."

THE Manchester Museum is one of the most flourishing of the provincial museums in this country, and its report for the year 1909–10 is good evidence that there has been no falling off in its usefulness and no disposition to interfere with its healthy and regular growth. During the year Mr. W. M. Tattersall has succeeded Dr. Hoyle as keeper of the museum. The number of additions to the collections has been large in every department, and the library has been considerably strengthened during the year.

THE first issue of the *Naturalist*, the journal of the Natal Scientific Society, has been received. We understand that this scientific periodical is the only one of its kind published in South Africa. It is edited by Mr. R. Denley James, and, in addition to containing the society's transactions and proceedings, includes several articles. Among the latter may be mentioned notes on the life-history of the Pseudacræa by Mr. A. D. Millar, and a short note on the Ixodidæ by the editor. The syllabus of work which the society hopes to accomplish during the present session shows that most branches of science are to receive attention, and that already the society has received gratifying support.

THE decay of building stones was discussed by Dr. Tempest Anderson at the recent Museum Conference at York, and his address is published in the October number of the *Museums Journal*. After showing that stone-decay is not due to wind action, the opinion is expressed that "it is not a surface action at all, but, I believe, a decay or rot affecting the substance of the stone, and, like other decays and rots, is in every probability caused by the action of some low organism, like the moulds and fungi which rot wood, canvas, and other vegetable materials. About two years ago, to test this view and endeavour to find a cure, as all efforts based on the abrasion or chemical theories had failed, I had affected stones treated with various germicides, and the stones which have since best resisted the decay were those treated with sulphate of copper (5 per cent. solution), bichloride of mercury, and creosote."

THE specimens of beaked whales (Ziphiidæ) in the collection of the United States National Museum form the subject of a profusely illustrated monograph, by Mr. F. W. True, published by the Smithsonian Institute as Bulletin No. 73. On account of the rarity of these cetaceans—exclusive, of course, of the bottle-nosed whale—the memoir

has an exceptional value to the students of the group, more particularly since the U.S. National Museum possesses, so far as the author could ascertain, about one-fourth of the whole available material. Of the genera Mesoplodon, Ziphius, and Berardius, Mr. True could find records of only about one hundred specimens in collections, of which more than half belong to the first genus, Berardius being known only by about fourteen examples. The most important addition to our knowledge of the group in recent years was the discovery of representatives of all three genera at Bering Island by Dr. Stejneger, two of these being regarded as distinct species, one of which was named in 1883 and the other in 1885. About six years ago it was ascertained that the range of the Bering Sea forms extends to the eastern North Pacific. After a descriptive catalogue of the specimens in the Washington Museum, with notices of some examples in other American collections, the author concludes his memoir with a list of the recognisable existing species of the group. Inclusive of the two representatives of Hyperoödon, this list embraces thirteen species.

THE November number of the *Quarterly Journal of Microscopical Science* (vol. lv., part iv.) contains a very interesting paper by Miss Muriel Robertson and Prof. E. A. Minchin on the division of the collar-cells of the calcareous sponge *Clathrina coriacea*. It appears that these cells multiply by longitudinal fission, the division of the nucleus being accompanied by a typical mitosis. The chief interest attaches to the behaviour of the "blepharoplast" in this process. In the resting cell this organ appears as a "basal granule" in connection with the flagellum; in mitosis it behaves as a typical "centrosome," dividing into two parts, which cave to lie at opposite poles of the nuclear spindle. Each of these daughter centrosomes becomes the blepharoplast of one of the daughter cells, and a new flagellum grows out from it. Around each new flagellum a new collar develops, the old collar and flagellum of the mother cell completely disappearing. The authors discuss the bearing of these facts upon the vexed question of the interpretation of the "kinetonucleus" in trypanosomes, and conclude that the latter is a true nuclear body, and not a blepharoplast or centrosome.

THE destruction of agricultural plant pests by chemical means is reviewed by Mr. H. C. Long in *Knowledge* (November). The practice is based on direct experiment, as plants differ considerably in their resistance to chemical solutions; thus charlock and dandelions are readily attacked by a copper sulphate solution, while *Cnicus arvensis* and clover are much more resistant. According to Bolley, shepherd's purse, *Camellina sativa*, chickweed, corn-cockle, bindweed, and plantain are all amenable to chemical treatment, whereas sow-thistle, *Bromus secalinus*, wild oats, and couch grass cannot be effectively controlled. The author directs attention to the desirability of carrying out systematised experiments in different parts of the country.

AN account of the Arnold Arboretum, well known by name to British botanists, is contributed by Mr. W. J. Bean to the *Kew Bulletin* (No. 8). Situated in a suburb of Boston, U.S.A., and extending over 200 acres, it is noted for the large collection of trees and shrubs in which north-east American and north Asiatic species predominate. A marked feature in the arboretum is the ground cover of shrubs in place of grass around the trees; various species of Vaccinium, Aster, Rubus, and other native shrubs are grown in this way. Mr. Bean pays a warm tribute to the energetic director, Prof. C. S. Sargent, for the excellent work that is being carried on; one of his greatest tasks has been the elucidation of North American species of Cratægus, of which specimens from type plants occupy 15 acres. A monumental work was provided by the "Silva of North America," in fourteen volumes, and another massive publication that will shortly appear is a bibliography of trees and shrubs of the world. Incidentally, the *Bulletin* contains evidence of cordial cooperation between Prof. Sargent and Kew in the publication of a list of new species of Impatiens from China, forwarded to Sir Joseph Hooker by Prof. Sargent for description.

THE report of the chief inspector of mines of the native State of Mysore for the year 1908 has just been issued, and affords satisfactory evidence that mining operations are being conducted here with energy and skill as well as with due attention to the safety of those engaged in the work. A small amount of manganese and chrome ore is being raised, but the principal mining operations are, as heretofore, confined to the Kolar goldfield. The report shows that there were ten companies at work, of which seven were producing gold, the value of the bullion produced being just over 2,000,000*l.* sterling, or almost exactly the same as in the previous year. The quartz raised contains gold to the value of just about 3*l.* per ton, the working costs amounting to about one-half of this figure. Elaborate tables are attached to the report, those relating to occidents being especially interesting. The accident death-rate is given as 4·70 per 1000 persons employed below ground, a figure which, though necessarily varying a good deal from year to year, shows upon the whole a downward tendency. A comparison with the similar figure for the Transvaal goldfields is decidedly in favour of the Kolar field, although in the Transvaal the accident death-rate per 100,000 tons of quartz treated is less than in Mysore, due to the greater efficiency of the Kaffir as compared to the Indian miner. In the Mysore there are about 4000 persons employed for each ton of quartz crushed, as against about 1000 in the Transvaal. A good deal of space in the report is devoted to a discussion of the "air-blasts and quakes," or violent bumps of ground, due apparently to the sudden relief of the strains in the ground as mining proceeds. These bumps have caused a good many serious accidents, and up to the present no means of preventing them has yet been suggested. It is to be hoped that a further study of this intricate question may lead at any rate to a determination of the conditions under which they are likely to occur, this being the first step towards taking measures to minimise the dangers resulting from them.

ON assuming his extraordinary professorship at the National University at Utrecht, Dr. E. van Everdingen delivered an interesting address, on October 17, upon "The Third Dimension in Meteorology." The establishment of a separate chair for meteorology was, he thought, an admission that it was now considered worthy of taking a place among the older sciences. If we inquired in what direction it had developed in the last twenty years, the answer undoubtedly was, in the third dimension: height. After glancing at the history of meteorology from the earliest times, he referred to the great importance of Buys Ballot's work in investigating simultaneous weather conditions and in formulating his law of the relation of wind to air-pressure, which is still the corner-stone of practical meteorology, and had infused new life into the subject. He discussed in considerable detail the various methods employed, and the valuable results obtained in the investigation of the upper air by (1) manned balloons; (2) kites; (3) captive balloons; (4) registering balloons (with instru-

ments); and (5) pilot balloons (without instruments). The use of Assmann's aspirating-psychrometer in manned balloons, and his employment of rubber both in registering and pilot balloons in lieu of paper, have proved of the greatest value. The author shows that much new light has been thrown upon questions relating to the general circulation of the atmosphere by the important discovery of the inversions of temperature at great heights and the existence of the isothermal layer, not only in our latitudes, but also in polar and tropical regions. At moderate heights these inversions play an active part in thunderstorm phenomena.

THE October number of *Himmel und Erde* contains an account of a popular lecture on the present position of wireless telegraphy, delivered six months ago by Dr. Karl Strecker, of the Imperial Post Office, Berlin. The account is well illustrated by diagrams, and is one of the best popular introductions to the subject we have seen. The author commences with the up-and-down oscillations of a weight supported by a spring, and the property such an arrangement has of setting in oscillation a similar arrangement suspended from the same beam as the first. By simple steps he passes to the oscillations of electricity in two conducting rods separated by a spark-gap, and to the way in which a duplicate apparatus at a distance will pick up the oscillations. The defects of the earlier apparatus are explained, and it is shown how in succession the means of detection of the oscillations and the means of producing them have been improved by the introduction of the coherer and by the utilisation of the oscillations produced by a cooled electric arc. Even the problem of privacy is not overlooked, and it seems the author considers rapid and prearranged changes of frequency of the oscillations as the future solution of the difficulty.

THE discovery by Messrs. Cotton and Mouton three years ago that a liquid may be rendered double refracting by the action of a magnetic field redirected attention to the Kerr effect, and as a result we now have theories which attempt to explain both effects. Prof. Voigt in his "Magneto- und Elektro-Optik" traces them to a direct effect of the electric or magnetic field on the electromagnetic oscillations which constitute light, while Prof. L. Natanson, in the June number of the Bulletin of the Academy of Sciences of Cracow, treats them as due to the directive action of the field on the electrons oscillating within the molecules. In the September number of *Le Radium* Prof. Langevin extends his theory of magnetisation so as to cover the two effects. According to him, the molecules of the liquid have axes along which the polarisation is an electric, and the magnetic moment in a magnetic field have values which differ from those in directions at right angles. Æolopropy of the molecule once secured, either on Prof. Natanson's or Prof. Langevin's theory, the investigation of the effects proceed along lines similar to those of Dr. T. H. Havelock's Royal Society paper of 1907, and leads to results in agreement with observation—that the amount of the double refraction is proportional to the square of the field, and the dispersion is expressed by Cauchy's formula.

AN interesting paper on the development of road locomotion in recent years was read by Mr. L. A. Legros at the Institution of Mechanical Engineers on Friday, November 18. It is difficult to realise the enormous increase in the use of the cycle both for pleasure and business purposes. It is estimated that about one person in every fifteen of the entire population of the United Kingdom is a cyclist. Post Office cycles cover a distance of 10,000 miles per annum per machine. The total number in use for postal purposes is 11,400. It is noteworthy that in the total mileage which has been run since the service was instituted, viz. about 600,000,000 miles, no fatal accident has occurred by the failure of any portion of a bicycle. The author estimates that the various public service horsed vehicles in London will become extinct as follows:—the horse-tramcar at the end of 1912; the horse-omnibus at the end of 1913; the hansom cab at the end of 1913; the four-wheel horse-cab before the end of 1921. The paper contains many useful suggestions regarding the management of traffic in London streets.

AN illustrated article on the removing of the wreck of the Quebec Bridge appears in the *Engineer* for November 18. The contract for clearing the site was awarded last December to Messrs. Charles Koenig and Co., of Quebec, and about half the quantity, viz. 5000 tons, has now been removed. A large amount of cutting has had to be done, and the choice of either dynamite or oxyacetylene for cutting a member is governed very largely by local conditions. Where the latter method has been used to greatest advantage has been in cutting up the heavy chords and posts into pieces that could be handled by the derricks, which have a capacity of not more than 10 tons. One web, 4 feet 6 inches deep, with a section of 190 square inches, was cut in 20½ minutes with a consumption of 112 cubic feet of gas. In cutting eyebars it was found that with a stream of pure oxygen gas one square inch of metal could be cut, on an average, in 5⅝ seconds, with a consumption of 0·4 cubic foot of gas, at a cost of 1·2 cents for the oxygen gas. Since the beginning of operations some 50,000 cubic feet of gas have been consumed, or an average of 10 cubic feet per ton of material removed.

MESSRS. SCHOTT AND GEN, of Jena, have sent us a copy of a well-illustrated catalogue of the new Jena glass laboratory requisites they are now in a position to supply. Extracts are published in the catalogue from a report from the Imperial Physico-Technical Institute, Charlottenburg, made after subjecting the new ware to various tests, and they indicate that these requisites, in comparison with older Jena glasses, have an increased power of resistance to sudden changes of temperature combined with a reduction of the amount of alkali given off into aqueous fluids.

OUR ASTRONOMICAL COLUMN.

THE TOTAL ECLIPSE OF THE MOON, NOVEMBER 16.—Not for many years have the conditions for observing a total eclipse of the moon been so generally favourable as they were on November 16. Reports from all over the country show how generally they were taken advantage of and appreciated, although, of course, no details of special scientific interest are yet published. Several meteors were observed before and during the eclipse, Mr. E. A. Martin having observed one at 6h. 55m. p.m. from South Norwood. Its path was from north-west to south-east, its colour reddish-yellow, and it was especially noticeable by reason of its extremely leisurely movement. Two faint meteors travelling in the same direction were seen from Gunnersbury during the eclipse. Madam de Robeck, writing from Naas, Ireland, states that the eclipse was a beautiful spectacle, and that she saw three meteors. One of these was a fine specimen, which travelled in a south-westerly direction from an apparent radiant just below the eclipsed moon. The penumbral shadow was barely discernible until after 10 p.m., when the relative darkening of the south-east limb could be detected. A slight flattening of the limb appeared to take place some minutes before the actual shadow could be seen on the disc, and throughout the eclipse the various prominent

lunar features were readily distinguishable through the deep copper-coloured shade. During totality the relative brightness of the limb was also noticeable, a thin ring appearing to encircle the darkened disc. The beauty of the phenomenon was considerably increased by the apparition of previously unseen stars, notably the Pleiades, when the extreme brightness of the moon was reduced. It is gratifying to notice that the new 8-inch equatorial of the Birmingham University Observatory was employed by Mr. Fournier in taking some fifteen photographs of the eclipsed moon during the various phases of the eclipse; exposures of from one to thirty seconds were given.

CERULLI'S COMET, 1910*e*.—Numerous observations of the comet discovered by Dr. Cerulli on November 9 appear in the supplement to No. 4454 of the *Astronomische Nachrichten*. As seen by Prof. Hartwig at Bamberg on November 11 the comet was of the tenth magnitude, round, 2′ diameter, and had a faint condensation.

From observations made on November 9, 10, and 11, Dr. Ebell has calculated a set of elements and an ephemeris, and from the former it appears that perihelion passage took place on September 15; at present the comet is about 95 million miles from the earth, and is receding at the rate of 720,000 miles daily. Apparently it is travelling nearly due south through the southern limits of Taurus, as shown by the following extract from the ephemeris:—

Ephemeris 12h. M.T. Berlin.

1910	α (true) h. m.	δ (true) ° ′	1910	α (true) h. m.	δ (true) ° ′
Nov. 23	3 37·3	+5 37·4	Dec. 1	3 36·9	+4 24·5
,, 27	3 37·0	+4 58·0	,, 5	3 36·9	+3 57·3

SELENIUM PHOTOMETRY OF STARS.—A paper of more than usual interest, in which the author discusses at length his measures of Algol, made with his selenium photometer, is contributed by Dr. Joel Stebbins to No. 3, vol. xxxii., of the *Astrophysical Journal*. The photometer was attached to a 12-inch refractor, and was kept at a uniform temperature of 0° C. or lower; the galvanometer current was kept working continuously, and between each ten seconds' exposure to a star the cell was rested for about a minute in order to recover; α and δ Persei were used as comparisons.

Under these necessary conditions very careful observations were made, and Dr. Stebbins considers that the results show the method to be capable of greater accuracy than is attained in visual observations. Among many interesting results accruing from the work, the following call for special mention. The companion gives more light than the sun, and is much brighter on the side turned towards Algol. A secondary minimum, some thirty-five hours after the principal minimum, was detected, the variation being only 0·06 magnitude. The discussion indicates that the radius of the companion is 1·14 that of Algol, while the limiting densities are 0·12 and 0·18 of the sun's density respectively. The total period comes out as 68·816h., and the duration of the eclipse as 9·8h. The greater luminosity of the one side of the companion, which appears to rotate and revolve in the same time, may be accounted for by supposing that it is intensely heated by radiations from the primary; this is in general agreement with Dr. Nordmann's suggestion that the temperature of Algol, as measured by his method, is great enough to raise the surface of the satellite to incandescence. Taking the parallax of the system as +0·07″ and the sun's magnitude as −26·6, the total light of Algol is 26; the total light of the faint hemisphere of companion is 1·7, and of the bright side 3·0; this would give stellar magnitudes of 2·2, 5·2, and 4·6 respectively. But if Kapteyn's adopted value for the parallax, +0·029″, and his magnitude of the sun, −26·1, be employed, these brightnesses become, respectively, 240, 16, and 28 times that of the sun.

Many other points, such as the density, magnitude, and form of the system of Algol, are also discussed in Dr. Stebbins's paper.

THE SECULAR ACCELERATION OF THE MOON'S MEAN MOTION.—In No. 4454 of the *Astronomische Nachrichten* Dr. Robert Bryant advances the tentative suggestion that the secular acceleration of the moon's mean motion may be due to the accretion of "dust" from interplanetary space by the moon and the earth. He finds that a deposit of 2 mm. of "dust" per century on the lunar surface would, if the density of the "dust" were equal to the mean density of the moon, account for about 6″ per century in the moon's longitude; a deposit on the earth would also be reflected in the longitude of the satellite.

It is also suggested that uniform distribution of the "dust" is improbable, hence irregularities would accrue. If the earth does collect sufficient "dust" in this way, its rotation period would be affected irregularly, and astronomy of precision would obviously be confronted by a serious difficulty.

PHOTOGRAPHIC MAGNITUDES OF SEVENTY-ONE PLEIADES STARS.—From the extra-focal images impressed upon thirteen plates taken early in March last, Herr Adolf Hnatek has determined the photographic magnitudes of seventy-one stars in the Pleiades group, and now publishes the results in No. 4449 of the *Astronomische Nachrichten*. The photographs were taken with the 14-inch photographic refractor of the Vienna Observatory, 10 mm. inside the focus, and the author publishes an interesting discussion of the results and the method whereby they were derived; an especially interesting point discussed is the effect on the apparent magnitude caused by the distance from the centre of the plate.

ELEMENTS AND NUMBERS OF RECENTLY DISCOVERED MINOR PLANETS.—Prof. Neugebauer publishes, in No. 4454 of the *Astronomische Nachrichten* the elements and permanent numbers of eighteen minor planets discovered during 1909; the last number allotted is 691, so that the total number of discoveries must, by now, be well above 700.

A NEW THEORY OF THE DESCENT OF MAN.[1]

THE first of the memoirs referred to below relates to the discovery of a new Palæolithic skeleton, and contains a careful report by Hauser on the excavation, along with a critical description of the skeleton and a comparison of the same with other known types, more especially with the Neanderthal man, from the pen of Prof. Klaatsch.

The conclusion arrived at is that the Neanderthal man and the Aurignac man represent two entirely different types of mankind.

According to Hauser's report, the skeleton of the Aurignac man was found early in 1909, at the Palæolithic site of Combe-Capelle, not far from Montferrand (Perigord), at a depth of 1·54 m. in a typical Aurignacian stratum, as was clearly proved by the artefacts found with the skeleton. The skeleton lay under a rock shelter, and was almost complete, the only imperfections being due to the displacement of certain parts by overturned masses of rock. As to the position of the body, the knees were strongly bent and drawn towards the head; the feet were also drawn together in a way which suggested a squatting position. After the whole skeleton had been removed, it was evident that the ground had been artificially prepared for the burial of the dead. There were found in the grave, typical Aurignacian artefacts of beautiful form, and perforated specimens of *Nassa reticulata*, a small marine snail, these articles being evidently intended for grave finery. The mode of burial showed the high state of culture of the Aurignac man.

A glance at diagrams of the Neanderthal and Aurignac skulls is sufficient to show the smaller breadth and more considerable height of the latter as compared with the former. Klaatsch directs attention to the stronger arching of the forehead of the Aurignac man, the greater bregma angle and calottic height, both according to Schwalbe's system as well as his own; the calottic height measurement of the Neanderthal skull is 40·4, while that

[1] H. Klaatsch und O. Hauser, "Homo aurignacensis Hauseri, ein palæolithischer Skelettfund aus dem unteren Aurignacien der Station Combe-capelle bei Montferrand (Périgord)." *Praehistorische Zeitschrift*, 1910, Heft 3–4, pp. 273–338, Tafel xxv–xxxv und drei Beilagen. (Berlin, 1910.)
H. Klaatsch, "Die Aurignac-Rasse und ihre Stellung im Stammbaum der Menschheit." *Zeitschrift für Ethnologie*, Jahrgang, 1910, Heft 3–4, pp. 513–577, Mit Tafel ii–iv und 46 Figuren im Text. (Berlin, 1910.)

of the Aurignac skull is 54·45. The excessive prominence of the Neanderthal skull in the frontal region is absent in the Aurignac skull, in which there is no development of an undivided torus supraorbitalis. Corresponding differences between the Aurignac and the Neanderthal skulls are found in the posterior region. The marked separation of the torus occipitalis transversus into a right and left half, which characterises the Neanderthal skull, is completely wanting in the Aurignac skull, of which the posterior region exhibits a quite remarkable conical extension. The place corresponding to the transverse inion prominence of the Neanderthal type is occupied by a sharp transverse ridge. The region of the planum nuchale lying below this shows a slightly hollowed surface.

In adults of primitive types of men, the sinus transversus does not coincide with the linea nuchae superior, as in modern Europeans. This condition is found both in the Neanderthal and in the Aurignac skull; it is, however, not to be regarded as evidence of an affinity between these two races, but merely as a character preserved from a common primitive condition.

In the temporal bone there is, in the case of the Aurignac man, a considerable protuberance of the conical-shaped mastoid, which contrasts strongly with the broad, low mastoid of the Neanderthal skull.

The cavity for the origin of the posterior belly of the digastric muscle is, in the case of the Neanderthal skulls (Spy, Moustier), wide and flat, and makes its appearance behind the mastoid. In the Aurignac skull the digastric groove is narrow and slight.

The tympanicum is, in the Aurignac skull, of remarkable delicacy, but is of considerable thickness both in the Moustier and Spy remains (Neanderthal type).

The formation of the facial bones also shows quite fundamental differences in the two types.

A fuller discussion of the anatomical details of the skeletons is outside the scope of a short article, and for this the reader is referred, especially as regards the anatomy of the extremities, to the original memoir.

The second memoir lays claim to the widest interest, especially as regards its conclusions about the general biology of man, and promises to open up new paths for the study of the morphological details of the skeletons of the primates. A series of special morphological results leads to the discovery of a parallel between the differences of the Aurignac and Neanderthal men, and the differences of the gorilla and orang-utan.

These considerations demand especially a rigid separation of accidental convergence phenomena from such characteristics of morphological details which must have been conserved by heredity alone, since they have no demonstrable connection with functional adaptations.

The external resemblance of the orang, of the gorilla, and of man in the sagittal and occipital crests is a convergence phenomenon. It is to be regarded as such because it is essentially a superficial resemblance, and exhibits great differences in its mode of origin. For example, the temporal muscles have left their imprint on quite different parts of the sides of the skull, from which it is to be inferred that before the beginning of this process the two skull forms were undoubtedly different, the orang having a higher forehead and a smaller supraorbital prominence than the gorilla.

On the other hand, Klaatsch finds in the ratio of the longitudinal and transverse diameters of the head of the humerus a morphological character which is important for the determination of affinities. We can here select only a few of the numerous details which serve as vouchers for the affinity between the orang and the Aurignac man on one hand, and between the gorilla and the Neanderthal man on the other.

The spina tuberculi majoris and the sulcus intertubercularis of the humerus in the case of Aurignac man and the orang run almost straight down, while in the case of Neanderthal man and the gorilla they both describe a medial convex curve. The peculiar rough insertion of the pectoral muscle is common to the Neanderthal and the gorilla. On the tibia, the relief of the posterior surface of the malleolus—the grooves for the flexor muscles—is deeper in the case of the orang than in the case of the gorilla; the same distinction holds between the Aurignac and the Neanderthal. On the femur, the trochanter minor in the case of the Neanderthal and gorilla is further down the shaft, and projects more inwards, while in the case of the Aurignac and the orang it projects backwards. The Aurignac-orang type exhibits also in the distal part a distinctly projecting, obliquely descending, crista intertrochanterica; in the Neanderthal-gorilla type there occurs that weakening of the ridge above the trochanter minor to which Klaatsch has already directed attention in the Neanderthal femur.

The shaft of the Aurignac femur is remarkable for its extraordinary straightness, and we find the same character in general with the orang. In contradistinction to this is the forward convex bend of the Neanderthal and gorilla femurs.

Klaatsch supports his theory by many more morphological details. Of special interest are the congruence phenomena which are shown by the curve diagrams of the tibia to exist between Aurignac and the orang and the gorilla and Neanderthal, as well as the similarity of the shaft proportions of the tibia of Spy and the gorilla.

All these details show that there exists an affinity in important morphological details between the Aurignac man and the orang-utan and between the Neanderthal man and the gorilla, and that this does not rest only on the general impression produced by the graceful and slender appearance of many of the parts of the orang and Aurignac as contrasted with the rough and thick-set build of the gorilla and Neanderthal.

These considerations unfold to us promising views of the coming problems of anthropology, and throw new light on our present conceptions of the phylogeny of the human race. From a study of the osteological details we are driven to the conclusion that at a very early epoch there branched off from the primeval common mass of our forerunners—Propithecanthropi, as Klaatsch calls them—a great western stream and a great eastern stream. Inside each of these groups new segregations occurred which led partly to the formation of races of anthropoid apes and partly to the formation of races of men.

The anthropoid apes are to be regarded as representing the unsuccessful attempts and dashes forward towards the goal of the definite creation of the human race—submerged branches of the primeval humanity which, in adapting themselves to special conditions of life, were

compelled in the struggle for existence to sacrifice important parts of their organisation, while a more favoured collateral branch, in quiet progressive evolution, developed into a human race.

By a new kind of diagram Klaatsch endeavours to elucidate the distribution of the human races and the anthropoid apes. The femur of Pithecanthropus fixes its position in the neighbourhood of the eastern group. The chimpanse is in many respects further removed from the gorilla than from the Neanderthal man. The African races exhibit some affinities with the Neanderthal type. As to the eastern people, the similarities between the skulls of young orangs and the skulls of Javanese, which impressed certain authors, require further investigation.

With the help of his new theory, Klaatsch promises us a new interpretation of single pieces of the diluvial find of Krapina, some of these apparently belonging to the Aurignac type and others the Neanderthal type.

Of all earlier finds, the skeletal remains from Galley Hill, Kent, have the greatest affinity with the Aurignac man. Less certain are the affinities of the skull from Engis. A new comparison of the other diluvial and early prehistoric finds from the point of view of the new theory appears to be highly desirable.

Richard N. Wegner.

MINERAL PRODUCTION OF INDIA.[1]

THIS quinquennial review of the mineral output of India is probably the last official publication of Sir Thomas Holland in his capacity as Director of the Geological Survey of India, and it is especially appropriate that this should be so, seeing not only that he originated this most useful form of publishing the records of Indian mineral production, but that he has been the first of all the directors of the Survey to recognise that the chief duty of this survey is to assist and encourage the development of the mineral resources of the country. It is an undoubted fact, to which the present report bears eloquent witness, that the mineral production of India increased during Sir Thomas Holland's directorship at a rate with which no previous similar period of Indian history can show any comparison.

A glance at the records before us shows that the last five years have continued the energetic development of the mineral resources of the peninsula; as pointed out by the authors, it is practically impossible to set up any unexceptional standard of valuation, so that accurate comparisons cannot well be looked for; yet, even allowing for this fact, an increase in the estimated value of the output from 3,455,565*l.* in 1898 to 5,047,201*l.* in 1903, and from this figure, again, to 7,880,832*l.* in 1908, is a clear proof of a steady rise in the exploitation of these important resources of our Indian Empire. Of the total value thus assigned to the production, about two-thirds are made up of two items, gold and coal, the latter being now by far the more important; in 1903 the value of the gold was nearly twice that assigned to the coal, whereas in 1908 the latter figure was about 50 per cent. greater than the former. The gold output has, in fact, remained just about stationary during the period under review, the great bulk of it coming, as hitherto, from the Mysore mines.

The important increase in the coal production is perhaps one of the most satisfactory features indicated in this report; from $1\frac{1}{2}$ million tons in 1884, the output rose steadily to $8\frac{1}{2}$ millions in 1905, and then more rapidly to nearly 13 millions in 1908. About 90 per cent. of the entire output comes from Bengal, and about 50 per cent. from a single coalfield, namely, Jherria, which is now the leading coalfield, having gone ahead of Ranigunj since 1906. A very interesting statement is here published concerning the geological age of these Bengal coalfields; they occur in the Damuda series of the Gondwana system, which has always been looked upon as of Mesozoic age, the Lower Gondwanas being classed as probably of Triassic and the Upper Gondwanas as probably of Jurassic age, thus making the coal-bearing formations much younger than those of Europe. On palæontological evidence, it is now possible to assert that the Lower Gondwanas are Palæozoic, and "certainly not younger than the Upper Carboniferous. Thus the Indian Coal-measures are not much younger than, and may even be of the same age as, those of Europe."

The only other point of especial importance is, in contradistinction to the first one, a purely economic one, namely, the fact that within the period under review the first battery of bye-product coke ovens has been erected on an Indian coalfield, namely, at Giridih.

During the five years to which this report refers the number of persons engaged in coal-mining has increased from 92,740 to 129,173, the numbers of those at work underground being respectively 64,969 and 83,164. The output has thus risen more rapidly than the number of persons employed, showing an increase in efficiency in the workers. The output per person employed has risen from 88·6 tons in 1904 to 98·8 tons in 1908, and per worker underground from 126·4 tons in 1904 to 153·5 tons in 1908. The efficiency of the Indian worker is thus approximately one-third of that of the worker in the United Kingdom; as is correctly pointed out in the report, this figure does not properly represent the ratio of labour efficiency, because in India a great deal of work is done by hand which in the United Kingdom is done by machinery, simply on account of the cheapness and abundance of labour in the peninsula. The death-rate from accidents has shown a marked tendency to increase during the last five years, but it is not possible to say whether this fact is due to the increasing depth of the mines or to accidental circumstances; its average over the five years 1904–8 is 0·98 per 1000 persons employed, or 10·2 per 1,000,000 tons of coal raised; the corresponding figures for the United Kingdom in 1906 were 1·29 and 4·37 respectively.

Another mineral that now bulks largely in the mineral production of India is manganese ore, the output of which shows a very marked increase, namely, from 150,190 tons in 1904 to 674,315 tons in 1908. The output in this latter year was about 228,000 tons less than that of the previous year, the falling off being due to market conditions, and in no wise indicating that the productive capacity has reached its zenith and is commencing to decline; on the contrary, it may be confidently anticipated that the general expansion above indicated will continue. The interesting economic question is raised whether it would not be preferable to smelt a considerable proportion of this ore on the spot, and thus export ferro-manganese instead of manganese ore; seeing that about one-fourth of the selling price of the ore represents the cost of freight, it is obvious that the possibility exists of effecting a very considerable saving, and the question should well merit investigation at the hands of the producers of manganese ore.

India is of great importance as a producer of mica, the Indian output being well over one-half of the world's total production. Here again a great increase is to be noted, namely, from 22,164 cwt. in 1904 to 53,543 cwt. in 1908.

The production of petroleum, still almost entirely from Burma, has also shown an increase, namely, from 118,491,382 gallons in 1904 to 176,646,320 gallons in 1908; even this latter figure is insufficient to supply the needs of the country, which imported about 70 million gallons in 1908.

It may be fairly said that the above comprise the mineral products of most importance; there are, of course, numerous others, and in most cases these show a marked increase in output. It is gratifying to find that the exertions of a scientific institution like the Geological Survey are having such a beneficial effect upon the economic development of the peninsula; and whilst congratulating Sir Thomas Holland upon the success in this direction that has attended his tenure of the directorship of the Geological Survey, we may express the hope that this expansion of the material interests of the country will continue to be the first care of his successors, with the same gratifying results.

H. Louis.

[1] "Quinquennial Review of the Mineral Production of India during the Years 1904 to 1908." By Sir Thomas H. Holland, K.C.I.E., F.R.S., and Dr. L. Leigh Fermor. Records of the Geological Survey of India, vol. xxxix. Pp. 280+8 plates. (Calcutta: Geological Survey; London: Kegan Paul and Co., Ltd., 1910.) Price 2 rupees.

SCIENCE AND ENGINEERING.

AT a meeting of the Junior Institution of Engineers on November 15, Sir J. J. Thomson, F.R.S., president of the association, delivered an address on the relations between pure science and engineering. The distinction between them, he said, is one of aim, not of method. The methods employed by the physicist and the qualities of mind called into play in his investigations are to a large extent the same as those used by the engineer in the higher branches of engineering. It is not the business of the physicist in his researches to concern himself at all with utility. Almost every advance in pure physics has been turned to account by the engineer, the manufacturer, or the doctor. But nothing would be more disastrous to the progress of engineering than that the workers in pure science should hamper themselves by considerations as to the utility of their work, or confine their attention to points which have an obvious practical application.

The province of engineering is to survey the facts known to science, and to select those which seem to have in them the possibilities of industrial application, and then to study and develop them from this point of view. This can often best be done in laboratories attached to works engaged in active trade. The success of works' laboratories in Germany and the United States, and to a growing extent in this country, is one of the most striking features in modern industrial development. A closer connection with pure science would be of the greatest service to engineering and commerce in this country, and though strides have been made in this direction in recent years, Sir J. J. Thomson pointed out we are still behind Germany in the importance we attach to pure science and in the eagerness with which new discoveries are applied to industrial purposes. As an instance, to judge from the number of "Thermos flasks" met with, the manufacture of these flasks must constitute a large and profitable business. It is said, however, that none of these flasks is made in England. Yet the Thermos flask is an English invention, being nothing but what is known to physicists as the "Dewar vessel," which was invented by Sir James Dewar for the purpose of storing liquid air without evaporation, and was described by him some years ago. Although the discovery was made and first published in England, no English manufacturer took it up, but left it to foreign rivals to make it the basis of an important trade.

It is, he continued, the object of applied science to keep theory and practice at the same level. Theory and practice do better work when they are driven abreast rather than in tandem. The more intimate the relation between the workers in pure science and those engaged in the application of science, the greater will be the opportunities of deepening the faith in science of the practical man. Faith in the results of pure science is more robust in Germany and the United States than in this country; here we cultivate more exclusively things which ripen quickly and yield an immediate return upon the capital invested, and are inclined to turn aside from projects which, though more profitable in the long run, will, so to speak, take a long time before they come into bearing.

ZOOLOGY IN THE INDIAN EMPIRE.

TO the September number of *Spolia Zeylanica* Prof. Punnett contributes an important paper, illustrated by two double coloured plates, on mimicry in Ceylon butterflies, with a suggestion as to the nature of polymorphism. After giving a list of the hitherto recorded instances, which are relatively numerous in comparison with the extent of the fauna, the author points out that this mimicry is far less striking among the living insects than in museum specimens. Not only is this difference apparent on the under surface of the wings when the insects are at rest, but it is still more noticeable in the mode of flight, so that with very little experience the eye learns to distinguish between the mimic and the mimicked. In the well-known case of *Papilio polyotes*, with its three phases of females, one of which closely resembles the male of the same species, while the second mimics the male of *P. aristolochiae*, and the third that of *P. hector*—both the two latter being inedible, while the first is edible—the author observes "that though model and mimic may be readily distinguished at rest, whether with wings expanded or closed, yet the resemblance between them may be sufficient to deceive such enemies as attack them when flying. Such, however, is certainly not the case. The mode of flight of *P. polyotes* is similar for all three forms, and is totally distinct from that of *P. hector* and *P. aristolochiae*.

After referring to the distribution of the three species and the relative numbers of the males and females of the different forms in various localities, the author states that the facts "are far from lending support to the view that the polymorphic females of *P. polyotes* have owed their origin to natural selection in the way that the upholders of the theory of mimicry would have us believe."

For Prof. Punnett's suggestion as to the origin of polymorphic females our readers may be referred to the original paper, as it is too long to quote, but it may be mentioned that Mendelism plays a part in the explanation. Mimicry in other species, together with the natural enemies of butterflies in Ceylon, is likewise discussed.

In the same issue Mr. George Duncker, after mentioning that although the group is common in the fresh waters of India and East Africa, none has been hitherto recorded from those of Ceylon, states that during the summer of 1909 he succeeded in obtaining examples of four species—one of which is new—of pipe-fishes of the family Syngnathidæ from the rivers of that island.

With the exception of one devoted to a South African frog allied to *Rana corrugata* of Ceylon, the articles in part iii. of the fifth volume of the Records of the Indian Museum deal with invertebrates of various groups. Among these papers is one by Dr. Annandale on a new genus of psychodid Diptera from the Himalaya and Travancore, based on a minute species from Darjiling, described earlier in the present year by Dr. Annandale as *Diplonema superstes*; this now becomes *Brunettia superstes*, while the new Travancore species is to be known as *B. travancorica*. In a second paper the same writer discusses the Indian scalpelloid barnacles of the subgenus Smilium, while in a third Mr. S. Kemp describes three new Indian species of the marine decapod genus Gennadas. Most interesting of all is an article by Mr. C. A. Pavia on the larvæ of a common Calcutta mosquito, known as *Toxorhynchites immisericors*. It was suspected that these larvæ feed on the larvæ of another mosquito, *Stegomyia fasciata*, frequently found in water contained in earthen vessels, and experiment has proved the surmise to be true. The larvæ of *T. immisericors* feed, in fact, greedily on those of Stegomyia, "and as *S. fasciata*, the yellow-fever mosquito, is very common in earthern pots round Calcutta, one is justified in assuming that *T. immisericors* plays an important part in its destruction, in a manner which would be of great moment in the event of yellow fever being introduced into the country."

R. L.

THE ARRIVAL OF MAN IN BRITAIN.[1]

THE address dealt with the antiquity of man as revealed in the geological record, and with the conditions under which Palæolithic man arrived in Britain. In the Tertiary period the higher (Eutherian) Mammalia appear, *en pleine évolution*, and afford the means of classifying it into the following well-marked divisions:—(1) The Eocene, in which living families and orders appear and there are no living genera. (2) The Miocene, in which there are living genera and no living species. (3) The Pliocene, in which the extinct species are preponderant and living species appear. (4) The Pleistocene, in which the living species are preponderant, and the extinct are few in number; Palæolithic man appears. (5) The Prehistoric, in which there are no extinct species of land Mammalia, and man is in the stages of culture marked by the use of Neolithic, bronze, and prehistoric iron implements. (6) The Historic period, in which the events are recorded in history.

In this classification the evolution of the Tertiary Mammalia takes the shape of a genealogical tree with

[1] Abstract of the Huxley Memorial Lecture delivered before the Royal Anthropological Institute on November 22 by Prof. W. Boyd Dawkins, F.R.S.

its trunk hidden in the Secondary period and its branches and twigs passing upwards through all the stages—a tree of life with the living forms as its fruit, the extinct species filling up the intervals between the living forms, and approximating to them in proportion as they approach nearer to the present day. In our search for the first traces of man on the earth, it is obvious that we cannot expect to find the most highly organised of the Mammalia in any portion of the geological record where there are no other living mammalian species, or, in other words, in the two earlier stages of the Tertiary period—in the Eocene, where there are no living Eutherian genera, and in the Miocene, where there are no living species. We may search for him in the Pliocene stage, when the living species come in, with some small chance of success, but our main efforts must be directed to the Pleistocene stage, when the living Eutherian forms were dominant and the face of nature as a whole was almost as it is to-day. If the doctrine of evolution be true there was no place for man in nature in the Eocene and Miocene stages, and if he had then been on the earth it is incredible that he should not, like all the other Mammalia then alive, either have become extinct or changed into a form that is no longer what it was before. As the evidence stands at present, man first appears on the earth in the Pleistocene age in that phase of the evolution of nature to which he belongs. The view of the higher antiquity of man based by M. Rutot on the presence of "eoliths," or chipped flints simulating the work of man in Eocene, Miocene, and Pliocene strata, is rendered untenable by the researches of Mr. Warren in this country and of MM. Boule and H. Breuil in France, who have proved that these forms can be, and in many cases have been, made by natural causes. These eoliths, therefore, cannot be used as anthropological documents in our inquiry.

The first starting point for our inquiry is presented by the discovery in 1894 of a skull and femur by M. Dubois in a Pleistocene river-deposit at Trinil, in Java, assigned by him to *Pithecanthropus erectus*, a form intermediate between the higher apes and man, and closely linked to the latter by the large brain and the erect gait. It is a veritable precursor of man, not only appearing at the point in the geological record where he might be expected, but in a tropical region taken by Lord Avebury and others to have been the birthplace of the human race. In Europe the implements and weapons of the Palæolithic hunter, associated with the bones and teeth of the animals that he hunted, afford ample proof of his presence in the caverns and in the river valley of the Pleistocene age over the whole region between the Mediterranean and the Baltic. The Palæolithic hunter presents two distinct phases of culture, those of the river-drift man and of the cave man, the former being the ruder and also the older, and the latter culminating in the wonderful artistic developments shown in the engravings, carvings, and painted frescoes of the caves of France and north-western Spain.

The conditions under which man found his way into Pleistocene Europe were strangely unlike those of to-day. The continent then extended southwards over the Mediterranean region, offering free passage to migration from northern Africa by way of Gibraltar and Sicily, and from Asia Minor by the elevation of the Ægean Sea and the Hellespont. On the Atlantic side the British Isles were united to France and Germany by the elevation of the beds of the intervening seas. On the east, too, a route of migration hitherto closed by a barrier of sea was offered to the Siberian fauna. The higher mountains were crowned with glaciers, and the climate was continental in character, with cold winters and hot summers. Under these geographical conditions the Pleistocene Mammalia invaded Europe both from the south and from the east and north-east at the close of the Pliocene age, and gradually took possession of the feeding grounds of the Pliocene fauna.

The invading forms may be divided into groups according to their present range, those that are now living (1) in temperate regions, (2) in northern, and (3) in southern climates. The first group, which includes most of the wild animals now living in middle and southern Europe, probably came from west central Asia. The second, including such Arctic species as the reindeer, musk sheep, and Arctic fox, came from the Siberian regions, and the third, represented by the lion, leopard, spotted hyæna, hippopotamus, caffer cat and others, came from the warmer regions, probably from northern Africa and perhaps Asia Minor. The extinct invading species, such as the mammoth and woolly rhinoceros, the cave-bear and the rest, also fall into one or other of these three groups. These animals ranged over the great Pleistocene continent, the northern so far to the south as the Alps and Pyrenees, and the southern over Spain and Italy, France and Germany, so far to the north as Yorkshire and Ireland, and both are found together in the caves and river deposits of the whole of central Europe and the British Isles.

There were, therefore, three distinct zones in Pleistocene Europe: the northern, into which no southern animal penetrated; the southern, in which no northern species is found; and the middle, extending from the Alps and Pyrenees over France, Germany, and the British Isles so far north as Yorkshire. In this the northern and southern forms were so mingled together that there can be no doubt that they lived at the same time. The spotted hyæna, for example, in the caves preyed upon the reindeer as well as the hippopotamus. This mixture of animals can only be explained by the migrating of these animals at different seasons in a continental climate with hot summers and cold winters, coupled with the secular changes in climate indicated by the development of an ice-sheet in the north and the spread of the glaciers over the lower valleys of the mountains.

The place of the river-drift man in these great migrations is clearly marked by his range. He came from the south, and his implements occur throughout the southern and middle zone so far to the north as Yorkshire. He also ranged in the Pleistocene age throughout northern Africa, Palestine, and Arabia into India, where he used the same implements as in Europe. He appeared and vanished along with the southern animals, and he lived in Europe during the time that the ice covered the higher grounds in the British Isles, as well as after the retreat of the ice from the districts which were covered during the maximum cold of the period.

The discoveries in the caves of Belgium, France, and Gibraltar establish the fact that the low type of river-drift man found in the Neanderthal cave ranged over those regions, and more recently Dr. Keith has noted it in the caves of Gibraltar. The river-drift man in Britain probably belonged to this primitive race.

The range of the cave man contrasts in every respect with that of the river-drift man. It is confined, with the solitary exception of the frescoed cave of Altamira, near Santander, to the region north of the Alps and Pyrenees, occupied by the northern group of Mammalia, the implements and weapons being met with in France, Belgium, Germany, and so far to the east as Moravia, and to the north as southern Yorkshire. They were successors of the river-drift men, and lived in the latest phase of the Pleistocene period.

Unfortunately, the caves of Great Britain throw no light on their physique. Nor are we helped in solving the problem by the caves of the Continent, because even if all the alleged discoveries be accepted, it does not follow that the same tribes lived in Britain. From the identity of their culture with that of the Eskimos, and from the fact that at various places in Siberia there are old camping grounds containing implements and the remains of the animals, both living and extinct, that are found in the caves of Britain and France, it is probable that the cave men have in remote times been in touch with the latter in northern Asia. The physical relations of the two peoples can only be decided by further discoveries in Europe, and especially by the archæological survey of Siberia. As the case stands now, the cave man probably came into Europe with the northern Mammalia from, and retreated with them into, northern Asia at the close of the Pleistocene period.

The Pleistocene period was undoubtedly of vast duration, and the antiquity of man is correspondingly great. It is to be measured by the sequence of geological events, by the changes in animal life, and by the advance in culture of successive races of mankind. It cannot be measured in years, because there are no chronometers in nature that record so small a unit of time. Outside history we

get a simple sequence of events following one another in due order, and with intervals of varying length, and these we are tempted to look upon without allowing for the perspective. The more minutely the events that have taken place since man appeared in Europe are examined, the more profound is the impression of the vastness of his antiquity and the futility of any attempt to compute it in terms of years.

THE DUKE OF THE ABRUZZI'S EXPEDITION TO THE KARAKORAM HIMALAYAS.[1]

THE expedition undertaken in the summer of 1909 by the Duke of the Abruzzi to the head of the Baltoro and the Godwin Austen glaciers in the Karakoram was essentially a mountaineering expedition. On the way out the longer summer route was followed across the Punjab Himalayas over the Zoji-La (11,230 feet), and down the valleys of the Dras and of the Indus, to Skardu, the capital of Baltistan. Here the route quits the Indus to ascend the Shigar and Braldoh valleys up to Askoley, the last inhabited spot, after which the glacier region is entered. While traversing Baltistan the expedition had the opportunity of seeing much of the Balti population and of photographing several groups of them. There can be no doubt that the great majority of the Baltis belong to the Aryan stock, and not to the Mongol-Thibetan, as has been stated by all English writers on the subject. The distinguished Hungarian anthropologist Ujfalvy had already demonstrated their close affinity to the Dards by comparative anthropometrical measurements.

A few miles above Askoley the Braldoh valley is intersected by the snout of the Biafo glacier. This glacier has undergone considerable variations in a recent period. In 1861, when Colonel Godwin Austen first visited it, it was wedged against the opposite or left bank of the Braldoh valley in such a way that the emissary stream of the Baltoro flowed through a tunnel underneath it. In 1892 Sir Martin Conway noted that it had withdrawn to such an extent as to leave free more than half of the valley, upon which it had deposited a deep layer of moraine. Since then the movement has again been forward, and in 1909 there were only from 200 to 300 yards between the snout and the rocks of the left wall of the valley.

On May 18 the expedition climbed up on to the Baltoro glacier. The snout of this glacier still corresponds absolutely with the description of it given by Conway in 1892. It may possibly be stationary, but certainly shows no sign of shrinking. All the tributary glaciers appear to be on the increase, and stretch out for a long distance on the top of the Baltoro, the surface of which they strew with broken seracs. Here angular measurements were taken, which were repeated two months later on the return journey, and established that the rate of motion of the centre of the glacier is on the average $5\frac{1}{2}$ feet a day during the months of June and July.

Later on the rate of the upper Godwin Austen glacier was observed. In the course of seven years the movement gave an average daily rate of barely 2 feet—considerably less than that of the lower Baltoro, although the grade is much steeper.

Near Rdokass were noticed on the glacier the strange pyramids of pure white ice which were first observed by Colonel Godwin Austen in 1861. At this point they appear as isolated cones, from 10 to 20 feet high; next as sharp pinnacles; and at last, higher up, as huge blocks from 100 to 150 feet in height, shaped like irregular prisms, and getting nearer and nearer together until they seem to be arranged in longitudinal rows.

The Karakoram range does not seem likely to offer an opportunity of solving the problem of the highest altitude attainable by man. The greater portion of the chain looks absolutely inaccessible. The difficulties of the ice and the rock are in most places so great that not even European alpine porters could carry up a load without the help of fixed ropes. This prevents the establishment of high camps, and was the obstacle which frustrated the Duke's one attempt to ascend K_2 by the rocky southeastern arête.

The exploration of the Godwin Austen glacier was completed by the end of June, and the Duke now decided to attempt the Bride peak (Karakoram No. 8 of T.S. of India, 25,110 feet), as being the highest and offering the additional advantage of having been trigonometrically fixed by the T.S. of India.

The Duke succeeded in establishing a camp on the Chogolisa saddle (20,778 feet), between the Golden Throne and the Bride peak. From this camp, an altitude of 24,600 feet, a little more than 500 feet below the summit, was reached on July 18.

The calculation of the altitude reached is based upon a barometric reading ($12\frac{9}{32}$ inches) referred to those taken on the same day at Skardu, Leh, Srinagar, and Gilgit.

The result of the survey is a map which comprises the upper basin of the Baltoro glacier, the whole of the Godwin Austen glacier, with its tributaries, which encircle three-fourths of K_2, and the mountain chains which enclose them. A number of new altitudes are given on the map. Of these, the most important is the one which assigns to the Broad peak an altitude of 27,133 feet. This altitude, added to that of Teram Kangri (27,610 feet), at the head of the Siachen glacier, brings up to seven the number of peaks now known to be above 27,000 feet. The other five are Mount Everest, K_2, the two peaks of Kanchenjunga, and Makalu.

The experience of this journey agrees with that of the Ruwenzori expedition in showing that the aneroid barometer is too delicate an instrument for mountain expeditions, and must be regarded as quite untrustworthy.

There is every reason to believe that the high regions of the Karakoram have a climate of their own which differs from that of the lower valleys, notwithstanding the shortness of distance as the crow flies. This experience confirms the observation recorded by previous explorers as to the absence of all electric phenomena in the atmosphere.

The expedition has recorded that the great chain of mountains comprising the Broad peak, the four Gasherbrums, and the Golden Throne, is composed of limestone and sedimentary rocks, whereas the opposite ranges, comprising the Staircase peak, K_2, and Bride peak, consist of crystalline rocks.

[1] Abstract of a lecture delivered before the Royal Geographical Society on November 21 by Dr. F. De Filippi.

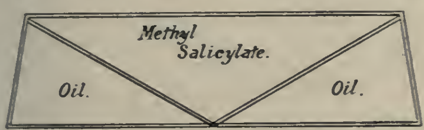
AHREN'S BILIQUID PRISM.

MR. C. D. AHRENS, the veteran prism-cutter, has lately devised a new type of liquid prism, which seems to have some advantages in optical work, both for direct-vision and for ordinary patterns of spectroscope. It is more than fifteen years since Wernicke proposed to employ in a direct-vision combination the highly dispersive liquid cinnamic ether. He found amongst modern sorts of optical glass one kind, a baryta crown, having the same mean refractive index, namely, 1·56, but having only about one-fifth as much relative dispersion. He was therefore able to make a flat-ended direct-vision prism by enclosing a glass prism of from 120° to 130° of refracting angle in a cell filled with the cinnamic ether, which thus constituted a triple combination, the glass prism being flanked by two reversed prisms of the ether. Several varieties of Wernicke's prism came into favour; but it had the drawback that cinnamic ether is expensive, and for some reason becomes cloudy after standing for a year or two in the containing cell.

More recently another highly dispersive organic liquid, also named by Wernicke, has found favour, viz. methyl salicylate. This substance has a mean refractive index of 1·5319, and its constringency (the reciprocal of its relative dispersion) is 24·7, as against 11·0 for cinnamic ether. Mr. F. Cheshire and others have used methyl salicylate with great success, in combination with reversed glass prisms, in apparatus that may be regarded as an improvement upon the prism of Wernicke. Methyl salicylate is, however, much cheaper than cinnamic ether, and does not become cloudy with lapse of time.

Mr. Ahrens has now produced a new type, the biliquid prism. It consists of a glass container divided by oblique partitions of thin plate glass into three triangular cells, one of which is filled with methyl salicylate, the other two with another liquid having a small dispersion relatively to

its refractive power. For the second liquid Mr. Ahrens has succeeded in finding in the paraffin series a white oil which is a suitable material in its mechanical as well as in its optical properties. It has not, however, the same mean refractive index as methyl salicylate, so therefore, for a direct-vision prism, the end faces cannot be square to the principal axis of the transmitted light. Their obliquity, however, is not great—not more than 15° if the refracting angle of the middle prismatic cell is from 120° to 125°. The dispersion of these prisms is very good, and there is much less absorption of the blue end of the spectrum than is usually found with a bisulphide or flint-glass prism. The writer, in a rough comparison of one of the Ahrens biliquid prisms with a Wernicke prism and a 60° bisulphide prism, found the following angular dispersions between



Ahrens's Biliquid Direct-vision Prism.

the C and F hydrogen lines:—bisulphide of carbon prism, 3° 27′; Wernicke prism, 3° 6′; Ahrens prism, 3° 12′.

If direct-vision is not desired, a prism of high dispersion can be made on the same biliquid plan by constructing a glass cell with the end faces at about 30° to the line of sight, and with internal oblique partitions at from 20° to 24° to the line of sight, dividing the whole into three prismatic chambers, the two outer of which are filled with methyl salicylate and the middle one with the white oil. This prism has marked superiority over a flint-glass prism of equal size. It must not, of course, be forgotten that all liquid prisms are unsuitable for fine definition of the spectral lines owing to the change of refractive index in the liquid when the temperature rises.

The biliquid prism is being put on the market by Mr. Pillischer.

THE REFORM OF MATHEMATICAL AND SCIENCE TEACHING IN GERMANY.[1]

THE revolt against formal culture which characterised mathematical instruction has within the last decade produced a large bibliography in English, French, and German, and inspired systematic inquiry into possible and needful reform. The movement has been assisted in Germany by an extension of the privileges of the Gymnasium to the Realgymnasium and the Oberrealschule, which in time may share the prestige of the Gymnasium and win for the exact sciences a place *ebenbürtig* with the classics.

When the Reformschulen were founded to provide a common foundation for all pupils in nine-class schools between the ages of nine and twelve, engineers were pronouncedly favourable, thinking that the exact sciences would benefit, and that an *Einheitsmittelschule* (secondary school with uniform curriculum) was in sight. But they were doubly disappointed; the classics have benefited, and the *Einheitsmittelschule* is condemned for systematic perfection.

Reform of mathematical and science teaching depends closely on the inexorable demands of civilisation, and for the understanding of modern culture a proper grasp of the meaning of a function is considered indispensable. On this account it is proposed to include analytical geometry and the calculus in the work of the nine-class schools. As no more time can be allotted to mathematics, any relief must come from further pruning of the syllabus. Hence elementary mathematics must be relieved of its lumber, the desire to achieve systematic perfection must be left unfulfilled, pedantic thoroughness must be killed by ridicule, and the exclusively deductive form abandoned, more value being attached to intuition than to a cunning use of the syllogism. Though mathematicians attack the isolation of their subject, they do not advocate *Fachbildung* (professional studies) in secondary schools. Professional bodies have always protested against it, and the protest has been taken to indicate the attitude of Trade Unions also. Nevertheless, German universities are trying to give the teacher an acquaintance with practical applications and arrange courses in applied mathematics or recognise attendance at technical high schools. The courses include descriptive geometry, mathematical methods of technical mechanics, surveying, life assurance, and laboratory work.

The introduction of practical work in the teaching of physics is urgently needed. It is provided in the best Prussian schools and in South Germany, notably at Munich, it forms part of the primary syllabus during the last two years. A statistical inquiry showed that 75 per cent., at least, of Prussian secondary schools desired facilities for experimental work, whilst only about thirty possessed them.

The minimum amount of time demanded is seven hours per week for science—physics, chemistry, biology, and geography—and four for mathematics. If proposals for introducing specialisation in the last three years are entertained, further hours may fall to the lot of the exact sciences.

The reintroduction of biology, which disappeared in 1879 as a result of the writings of Darwin and Haeckel, is being advocated as a training of the powers of observation, in which the German freshman is said to be woefully deficient, and as an exercise in the use of the microscope. Geography comprises economic geology, *Erdkunde*, and astronomy, as well as commercial products. To bring it into organic connection with mathematics, courses of lectures on the interconnection of mathematics are being projected.

Matters are still in an indefinite position, but there are indications that the Cambridge Congress of 1912 will mark the beginning of a new era. It is to be hoped, for our sakes, that the results of this congress can be laid before the Consultative Committee of the Board of Education to be recommended for adoption throughout the Empire.

[1] Abstract of paper read at the meeting of the Edinburgh Mathematical Society on November 11 by Mr. A. J. Pressland.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Mr. John Dale has been awarded the Walter Myers studentship for a further period of one year, having proved himself a student of exceptional merit. An award of the same studentship for the present year has been made to Mr. Cranston Walker. The value of the studentship is 150*l*. per annum, and it must be used for research in pathology or clinical medicine at some German university. Mr. Dale, the first holder, is working at Hamburg, and Mr. Cranston Walker is at the University of Freiburg, in Baden. The holder must possess a degree in science in addition to degrees in medicine and surgery.

CAMBRIDGE.—An election to an Isaac Newton studentship will be held in the Lent term, 1911. It will be the duty of the student to devote himself during the tenure of his studentship to study or research in some branch of astronomy or of physical optics, according to a course proposed by himself and approved by the electors. The student's course of study or research must be pursued at Cambridge. The studentship will be tenable for the term of three years from April 15, 1911. The emolument of the student will be 200*l*. per annum. Candidates for the studentship are invited to send in their applications to the Vice-Chancellor between January 16 and 26, 1911, together with testimonials and such other evidence as to their qualifications and their proposed course of study or research as they may think fit.

Mr. A. E. Shipley, F.R.S., master of Christ's College, has been nominated by the general board of studies as a member of the board of electors to the professorship of zoology and comparative anatomy in succession to the late Mr. J. W. Clark; and Prof. W. J. Pope, F.R.S., has been nominated by the council of the Senate a member of the board of electors to the Allen scholarship.

OXFORD.—On November 22 another stage was reached in the discussion of the changes proposed by the Hebdomadal Council at the instance of the Chancellor of

the University. The preamble of a statute providing that Greek should no longer be a compulsory subject in Responsions was promulgated in Congregation, and on a division was rejected by 188 to 152. The form of statute was introduced on behalf of council by Mr. Matheson and opposed by Dr. James, president of St. John's College, and formerly headmaster of Rugby. Sir W. Anson, warden of All Souls', though not opposed to making Greek optional in certain cases, spoke against the proposal in its present form, a course which was also taken, on similar grounds, by Dr. Gilbert Murray, regius professor of Greek, and Mr. J. W. Mackail, professor of poetry. Mr. Cookson advocated the passing of the statute, and Prof. J. A. Smith argued on the same side. Mr. E. M. Walker opposed it. There is no doubt that the rejection of the preamble, which involves the loss of the statute, was largely due to the objection taken by Prof. Murray and the "moderate" party to the particular way in which the proposal had been framed. Rightly or wrongly, it was considered that no proper opportunity had been allowed for a fair discussion of possible limitations and alternatives, and the majority shrank from a measure that appeared to them unnecessarily drastic. Though for the present excluded by the vote of Congregation from the programme of university reform, it is not likely that the Greek question will be allowed to rest. But it must be remembered that, even if presented in a form acceptable to Congregation, the measure of relief has still to run the gauntlet of Convocation before becoming part of the statute law of the University.

IT is announced that an Imperial Conference on Education is to be held in London next year, probably in April. The conference is, it is said, to take place at the invitation of the Imperial Government, and is to be regarded as an outcome of the congress held in 1907 under the auspices of the League of the Empire. Delegates are expected from Canada, Australia, New Zealand, South Africa, India, and the Crown Colonies.

THE U.S. General Education Board, says *Science*, has made conditional appropriations amounting to 145,000*l*., distributed as follows:—Baylor University, Waco, Tex., 40,000*l*.; Trinity College, Durham, N.C., 30,000*l*.; University of Chattanooga, Tenn., 30,000*l*.; Meredith College, Raleigh, N.C., 10,000*l*.; Wesleyan Female College, Macon, Ga., 20,000*l*.; and Amherst College, Amherst, Mass., 15,000*l*. From the same source we learn that Wooster University has received 20,000*l*. from Mrs. J. S. Kennedy, of New York.

As has been stated in these columns, a Congress of the Universities of the Empire is to be held in London in 1912. On November 19 a meeting was held at the University of London, at which the Vice-Chancellors and other representatives of the universities of the United Kingdom were present for the purpose primarily of drawing up a paper of subjects for discussion at the congress. The subjects fell under the following heads:—(1) university organisation; (2) universities in their relation to teachers and undergraduate students; (3) universities in their relation to post-graduate and research work; (4) universities in their relation to schools and to other agencies for higher education. The draft agenda paper is to be sent at once to the various universities in the colonies and in India for comments and suggestions. The representatives of the Home universities will meet again early next summer to consider any representations made by the Colonial and Indian universities, and to select speakers to introduce the different topics to be discussed at the congress. It has been decided to hold the congress during the first week of July, 1912. We are glad to know that most of the universities throughout the Empire have accepted already the invitation to take part in what should prove an important and historic gathering. The secretary of the congress is Dr. R. D. Roberts, who may be addressed at the Congress Office, University of London, South Kensington, London, S.W.

LAST April Sir Henry Roscoe, F.R.S., as chairman of the Appeal Committee, made a public appeal for 70,000*l*. for providing new chemical laboratories at University College, London, including the purchase of the proposed site in Gower Place. The death of King Edward led to the postponement of the Mansion House meeting arranged, and this necessity gave a check to the work of the committee. Sir Henry Roscoe has now made a second urgent appeal, which has two objects: the first is to raise a sum of 25,000*l*. for the acquisition of the proposed site, the second to raise 45,000*l*. to erect the laboratories. The sum of 25,000*l*. must be raised before December 25 next if the Senate of the University is to be in a position to exercise the option which it holds to purchase the site. Towards this sum the committee has collected more than 9000*l*., leaving a balance of 16,000*l*. to be raised forthwith. The appeal is addressed especially to all those who realise the national importance of scientific research and its bearing upon the commercial prosperity of the country, to Londoners who desire to see university teaching in London developed in accordance with the needs of the nation, and also to the friends and admirers of Sir William Ramsay, the professor of general and inorganic chemistry at University College, to assist in this attempt to provide new chemical laboratories by gifts which will insure the acquisition of the site. It is earnestly to be hoped that the comparatively small sum of 16,000*l*. will be forthcoming before Christmas Day, so that the site adjoining the college, and eminently suitable for the proposed laboratories, may be secured. It may be pointed out that the number of students of chemistry at University College has increased greatly in recent years, and that the accommodation available has long been inadequate. The present laboratories were built in 1871, and to keep pace with modern requirements and to compete on something like equal terms with Continental universities a new building is required with up-to-date conveniences both for teaching and research. Donations should be addressed to Sir Henry E. Roscoe, F.R.S., at University College, Gower Street, London.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 17.—Sir Archibald Geikie, K.C.B., president, followed by Mr. A. B. Kempe, vice-president, in the chair.—Harold **Wager**: The effect of gravity upon the movements and aggregation of *Euglena viridis*, Ehrb., and other micro-organisms. *Euglena viridis* and some other micro-organisms, when placed in shallow vessels or narrow tubes in the dark, become aggregated into peculiar network-like patterns or more or less well-defined groups. In a narrow tube, placed horizontally in the dark, the aggregation takes the form of a series of groups which look like green bands crossing the tube from one side to the other. Each group shows a constant cyclic up and down movement, the denser central region moving downwards under the influence of gravity, and a lighter peripheral area consisting of organisms moving upwards, mainly by their own activity. The aggregation depends upon the number of organisms present, their activity, and the depth of the vessel in which they are contained, and may persist with its regular cyclic movements for several days. The downward movement appears to be a purely mechanical one, dependent upon the specific gravity of the organism, and is not due to a stimulus which evokes a physiological response, as in geotropism or geotaxis. The upward movement is, on the other hand, due partly to the activity of the organisms themselves, partly, no doubt, to the upward currents set up in the liquid by the friction of the downward-moving stream. The upward movement of Euglena is more or less vertical, and appears to be controlled, so far as the orientation of its elongate body is concerned, by the action of gravity. The aggregation resembles the cohesion figures produced when fine sediments are allowed, under certain conditions, to settle down slowly in a liquid, and are probably brought about much in the same way. The movements of certain micro-organisms are apparently controlled, therefore, in a purely mechanical fashion by gravity, combined with cohesive forces, and this is of advantage to species which, like Euglena, are often found in large numbers in a confined space, in that it prevents their accumulation in such dense masses as would be likely to interfere with their assimilatory and respiratory functions.—Miss Jean **White**: The

proteolytic enzyme of drosera.—L. S. **Dudgeon**, P. N. **Panton**, and H. A. F. **Wilson**: The influence of bacterial endotoxins on phagocytosis (including a new method for the differentiation of bacteria). Second report. The authors have failed to demonstrate in any of their experiments an action of the endotoxic substances on the leucocytes, and experiments leading to similar results were obtained by allowing bacteria to be exposed to the action of the specific endotoxic substances. They confirm the results published in the first communication, that the phagocytic result is dependent upon the interaction of endotoxin of serum. They have shown in the case of normal serum that the amount of phagocytosis permitted when bacteria and endotoxin interact is not related to the amount of hæmolytic complement present. The action of endotoxin appears to be specific even with bacteria so closely related as the typhoid and paratyphoid family. These results strongly suggest that this method can be employed for the differentiation of bacteria. The amount of endotoxin has been shown to be strongly thermostable.—S. B. **Schryver**: Some investigations on the state of aggregation of matter. Parts I.–III. *Part I. The action of salts in heterogeneous systems and the nature of the globulins.*—When complex substances, such as those which form colloidal solutions, enter into chemical reaction, the ordinary laws of chemical mass action are not always obeyed, the deviations therefrom depending upon the medium in which the reaction takes place. These are due to the adsorption of molecules from the medium on the surface of the large molecules of the colloid, which sterically inhibit chemical reaction. These conclusions were deduced chiefly by the study of the action of formaldehyde on Witte's peptone, whereby a methylene-imino derivative is formed, which readily, either by polymerisation or condensation between two molecules, forms an insoluble complex. The formation of this complex is inhibited by the presence of salts, the inhibitory action of a series of which has been quantitatively measured. The degree of inhibition was found to depend, in the case of monobasic sodium salts, on the physical properties of their aqueous solutions. The lower the surface tension and the lower the viscosity of the solutions, the greater the inhibitory action. The effect of surface tension could be deduced from the general study of adsorption phenomena, whilst the effect of viscosity could be deduced by the extension of the generalisations of Whitney and Noyes, and of Nernst as to the reaction rates in heterogeneous systems. The globulins, which are insoluble in water but soluble in salt solutions, are assumed to be complexes formed by the action of a basic group in one molecule with an acid group in another, by means of which a salt is formed, which undergoes slight but definite hydrolytic dissociation in the presence of water. In the presence of most salts, owing to adsorption by the dissociated globulin molecules, hydrolysis proceeds further than in presence of water alone, with the consequence that more globulin is dissociated and "dissolved." The solvent action of the salts here again depends upon the surface tensions of the solutions. Salts exert also a similar action in other heterogeneous systems in bringing about disaggregation, and the differences of solubility of various crystalline substances in salt solutions can be thereby explained. The physical constants of the salt solutions employed, and the solubilities of edestin and serum globulin in these solutions, are given. *Part II. The action of formaldehyde on Witte's peptone.*—The experimental details of this investigation are given. It is shown that the insoluble precipitate, formed by the interaction of the solutions, is derived chiefly from the more complex polypeptides. *Part III. The solubility of phenol and certain crystalline substances in salt solutions.*—The deductions as to the action of salts in heterogeneous systems are illustrated by the determination of the critical solution temperatures of phenol and salt solutions, which is a function chiefly of the surface tensions of the latter, and of the solubility of the following substances in salt solutions:—*d-l*-leucine, *d-l*-phenylalanine, caffeine, benzamide, and *p*-toluidine. The solubilities are affected by both the surface tensions and viscosities of the solutions.—F. W. **Twort**: A method for isolating and growing the lepra bacillus of man. Experiments were undertaken to obtain a method whereby the lepra bacillus of man and allied bacilli might be cultivated outside the body on artificial media. The material tested was obtained from a typical leper. Cultivations were made on ordinary laboratory media and on media containing extracts from animal organs and tissues; these gave negative results. In view of the close relationship between the tubercle bacillus and the lepra bacillus, it appeared highly probable that these two micro-organisms would require the same chemical substances for building up their protoplasm which could be elaborated from the ordinary media only by the tubercle bacillus. It was thought that if these substances could be supplied already formed to the lepra bacillus it might grow, and the easiest method of supplying these substances would be by adding to some good medium the ground-up bodies of the tubercle bacilli containing them; accordingly a medium was made as follows:—egg three parts, 0·8 per cent. sodium chloride one part, ground tubercle bacilli 1 per cent., and glycerine 5 per cent. or less, mixed, placed in tubes, sterilised, and set in slopes. Leprosy material was placed in 2 per cent. ericolin to kill contaminating micro-organisms, and then inoculated on the tubercle medium. On this the lepra bacillus grew very slowly as a delicate, colourless streak along the inoculated track, and showed the typical morphological and staining characters of the lepra bacillus; the bacillus could be sub-cultured only on the tubercle medium. Experiments will be made to prepare a lepra vaccine and to grow the lepra bacillus of rat. In conjunction with Mr. Ingram, the author has also succeeded in growing the bacillus found in Jöhne's disease of cows. It grows on the same medium, much like lepra bacillus, but somewhat faster. It is hoped soon to prepare a diagnostic vaccine for Jöhne's disease.—G. J. **Fowler**, E. **Ardern**, and W. T. **Lockett**: The oxidation of phenol by certain bacteria in pure culture. The investigation described in the paper arose out of a detailed examination of the effect of various antiseptic substances, including phenol, in bacterial sewage filters. It was found that the phenol apparently exerted a selective action on the bacteria present in the filtrate, only very few types appearing in the filtrate, more especially a liquefying organism (*B. liquefaciens fluorescens*) and a chromogenic organism. Pure cultures of these organisms were made, the medium generally used being ordinary peptone broth. The general method of experiment was to bubble air, under sterile conditions, through an aqueous solution of phenol to which a few c.c. of the culture were added. The strengths of phenol solution used varied from 8·4 to 16·5 parts phenol per 100,000 of water, and were determined by the oxygen absorbed from standard acid permanganate solution in three minutes. It was found that *B. liquefaciens* had no action, or only a very slight one, on phenol, even after exposure of a month or more, while on introduction of the chromogenic organism the phenol content diminished, slowly at first, and then, in two or three days, completely disappeared. In a final experiment, a solution was made use of containing 10 parts per 100,000 of phenol, together with the following ingredients:—

Ammonium sulphate...	...	0·1 grm.	per litre.
Potassium phosphate...	...	0·1 ,,	
Magnesium carbonate in suspension.	...	½–1 ,,	

After careful sterilisation this was inoculated with the organism, and incubated. After nine days the phenol had practically disappeared. Plate cultures were also made at the expiration of this time, and showed no evidence of the presence of more than one species of organism. The organism has been examined by Dr. Sidebotham, who concludes that it most nearly resembles *B. helvolus* (Zimmermann).

Mineralogical Society, November 15.—Prof. W. J. Lewis, F.R.S., president, in the chair.—J. H. **Collins**: Further notes on wood-tin. It is concluded that wood-tin, which always contains a good deal of iron oxide, and is much more opaque and more soluble than ordinary cassiterite, is the chalcedonic form, the shot-tin having had a concretionary, and the botryoidal form a stalagmatic, origin.—J. M. **Coon**: The alteration of the felspar of granites to china-clay. The action has taken place from within the earth towards the surface below the underground water-

level, the water outlets being generally indicated by schorl and quartz veins. The nature of the products of the alteration was discussed.—Prof. W. J. **Lewis**: Wiltshireite, a new mineral from the Binnenthal. The crystals were tin-white in colour, russet-brown when tarnished; small, but aggregated in parallel position, with monoclinic symmetry $a : b : c = 1{\cdot}587 : 1 : 1{\cdot}070$; $\beta = 100°\ 44'$. Paucity of material prevented a chemical analysis, but no doubt it is a lead sulpharsenite. Named after the late Rev. Prof. T. Wiltshire.—Arthur **Russell**: A new locality of phenakite in Cornwall. A single specimen showing numerous colourless prismatic crystals of phenakite was found by the author at Wheal Gorland, Gwennap, Cornwall, this year. The specimen was obtained from a lode at present worked for wolfram and traversing the granite close to its junction with the killas.

Institution of Mining and Metallurgy, November 16.—Mr. Edgar Taylor, president, in the chair.—A. Moncrieff **Finlayson**: Secondary enrichment in the copper deposits of Huelva, Spain. This paper embodies the results of an investigation of variations in the ore-content of the lodes in the mining district named, with subsequent microscopic examination of the ores, with the view of determining the paragenesis of the minerals and the nature and extent of alteration. The following general conclusions were arrived at:—that the copper in the pyrites occurs primarily as a definite mineral (chalcopyrite), and is not chemically combined with the pyrite; that the order of deposition of the primary minerals was pyrites, chalcopyrite, blende, galena; that the processes of secondary enrichment consist, in lean ores, in a change from chalcopyrite to chalcocite, and in richer ores in a gradual aggregation of secondary chalcopyrite accompanied by chalcocite; that the preliminary changes due to enrichment extend to considerably greater depths than is indicated by the percentage composition of the ore. The characteristic process is undoubtedly the formation of chalcocite from chalcopyrite, chalcocite being formed, in part at least, during the oxidation of the leached heaps.—J. Bowie **Wilson**: Notes on the Mount Morgan ore deposits, Queensland. This paper is a brief account of the development of these deposits, brought up to date, the latest of previous technical papers on the subject being at least ten years old. Considerable space is devoted to a consideration of the geology of the deposit. The author considers that the deposit was formed in an area of country rock much shattered by intrusive dykes, which has allowed free circulation of ascending mineral-bearing solutions, the mineralisation occurring simultaneously with metamorphism of the original sedimentary rocks forming a background to the deposit. He admits, however, that there are several phenomena which do not absolutely fit in with his theory.—D. M. **Levy**: The successive stages in the bessemerising of copper mattes as indicated by the converter flame. This paper, which is accompanied by four coloured plates reproduced from Lumière photographs, deals with the two main stages in the process of bessemerising copper mattes, the "slagging" stage, during which the iron-sulphide is eliminated, and the second stage, during which the sulphur is finally eliminated, the slag being poured off and the white metal blown up to blister copper. The colours of the flames at these two stages are characteristic, and there are other points, at first blowing and at the end of the slagging stage, when the flame colour is equally indicative of the stages reached in the complete operation. The author follows out the process in detail, and appends observations made during a typical "blow."

Royal Meteorological Society, November 16.—Mr. H. Mellish, president, in the chair.—Miss M. **White**: Results of the hourly balloon ascents made from the Meteorological Department of the Manchester University, March 18–19, 1910. Twenty-eight small rubber balloons carrying Dines's meteorographs were liberated hourly, and of these twenty have been recovered. The balloons left Manchester going at first in a southerly, and later south-easterly, direction, and were found in the Worcester, Hereford, and Monmouth districts, one reaching North Devon. The direction of the upper wind was constant during the period over which the ascents extended, and did not vary with height. The average height of the stratosphere was 10·7 km. Whereas at the ground level the temperature was remarkably constant throughout the course of the experiments, showing a maximum variation of fewer than 2° from the mean, the isothermals at the higher levels show a well-marked rise throughout the first fifteen hours; *e.g.* a temperature of −40° C. was at first encountered at a height of 6 km., but continued to recede, until at the end of twelve hours it was not met with until 8 km. height.—W. H. **Dines**: Results obtained from the registering balloon ascents carried out during the two international weeks, December 6–11, 1909, and August 8–13, 1910. Balloons on each occasion were sent up from Manchester, Pyrton Hill, Ditcham Park, Crinan in Scotland, and also in the west of Ireland. Seventeen records were secured in the December ascents, and these show that the value for the height of the isothermal column or stratosphere are some of the lowest ever observed, and the temperatures are perhaps the lowest ever recorded, at a height of 5 miles. Of the balloons sent up in the August week seventeen were found. The average height attained was about 10 miles. The inversion of temperature at the commencement of the isothermal layer was larger than usual.—C. J. P. **Cave**: Pilot balloon observations made in Barbados during the international week, December 6–11, 1909. These observations, which were undertaken at the request of the Royal Meteorological Society, were carried out by Mr. Radcliffe Hall and several other gentlemen associated with him. The prevalence of clouds during the daytime interfered with the ascents, many of the balloons being lost to sight after a few minutes. It seems that the wind behaves like an east wind in this country, increasing to a maximum and then falling off above.—W. **Marriott**: Three registering balloon ascents carried out at the Royal Agricultural Society's Show at Liverpool on June 21–23.—Captain C. H. **Ley**: The irregularities of the wind at moderate altitudes.

CAMBRIDGE.

Philosophical Society, October 31.—Prof. Hobson, vice-president, in the chair.—Sir J. J. **Thomson**: A new method of investigating the positive rays. In this method the rays are received on a photographic plate inserted inside the discharge tube, and placed in a light-tight case until it is wished to photograph the rays, when the plate is lifted from its case by a mechanism worked from the outside, and the rays are allowed to fall upon it. It is found that a photographic plate is very sensitive to the rays; a pencil of these only one-third of a millimetre in diameter gave a good photograph in less than five minutes. The photographic plate, besides being much more sensitive than the willemite screen hitherto used by the author, has the advantage of giving a permanent record and allows of greater accuracy of measurement. Using this method, the author has detected in the positive rays, in addition to the atom and molecules described in his paper in the October number of the *Philosophical Magazine*, positive rays of a secondary nature having values of m/e, 1·5, 2·5, &c., that for the hydrogen atom. Photographs taken by this method were exhibited at the meeting.—R. **Whiddington**: Preliminary note on the properties of easily absorbed Röntgen radiation.—R. T. **Beatty**: The ionisation of heavy gases by X-rays. When X-rays pass through matter their energy is absorbed in the production of δ, β, and γ rays. X-rays the absorption of which in aluminium ranged from $\lambda = 230$ to $\lambda = 4$ were passed through AsH_3 and SeH_2, and the absorptions in these gases were measured. It was found that β and γ rays occurred together when the characteristic γ radiation of SeH_2 was excited. On subtracting the increase in ionisation due to these rays, the ionisation due to the direct formation of δ rays, relatively to the ionisation in air, remained constant for all the radiations used. It thus appears that the processes which go on when the characteristic radiation is produced do not alter the rate at which direct ionisation takes place in the gas. Incidentally, Lenard's law of absorption of corpuscular rays is confirmed to a few per cent.—S. G. **Lusby**: The mobility of the positive ion in flames. The mobility of the positive ions due to salt vapours in a flame was determined in these experiments. It was found that for all salts of all metals of the alkali and the alkaline earth groups this mobility was a constant

quantity, and at a temperature of 1500° absolute was 290 cm. per second. From a theoretical formula it was further deduced that the ion at this temperature had the mass of a hydrogen atom. Experiments are proceeding to test further this latter result.—G. W. **Todd**: Mobility of the positive ions in gases at low pressures. By an adaptation of Rutherford's alternating field method, the mobilities of the positive ions produced in gases by means of X-rays have been measured between pressures of 1 and 25 millimetres of mercury. Unlike the negative ions, no change was observed in the law that the product of the pressure and the mobility is constant for the same gas. Further experiments are in progress with the positive ions given off from aluminium phosphate.—G. H. **Hardy**: Fourier's double integral and the theory of divergent integrals.

PARIS.

Academy of Sciences, November 14.—M. Émile Picard in the chair.—The president announced the death of M. Tannery, free member of the academy.—M. L. Teisserenc de Bort was elected a member in the place of M. E. Rouché.—A. **Perot**: The spectroscopic measurement of the rotation of stars possessing an atmosphere, with special reference to the sun. A mathematical investigation showing that, in the absence of knowledge as to the true direction of the light ray at the point where it meets the reversing layer and of its propagation in the layers through which it then passes, caution is needed in translating radial velocities into velocities of rotation.—M. **Javelle**: Observations of Halley's comet made at the Nice Observatory with the Gautier equatorial of 76 cm. aperture. Observations are given for November 3, 8, 10, 11, and 12, together with the positions of the comparison stars. The comet was extremely faint, being reduced on November 3 to a vague white spot about 1′ in extent, without visible condensation.—P. **Chofardet**: Observations of Cerulli's comet (1910*c*) made at the Observatory of Besançon with the bent equatorial. Data are given for November 10, 11, and 12. The comet appeared as a round nebulosity 30″ to 40″ in diameter, and was estimated to be of the eleventh magnitude.—M. **Coggia**: Observation of Cerulli's comet made at the Observatory of Marseilles with the Eichens equatorial of 26 cm. aperture. Data given for November 11.—Louis **Bachelier**: The movement of a point or material system submitted to the action of chance forces.—M. **Arnodin**: The bridge at La Cassagne (Gisclard system). An account of a suspension bridge of a new type constructed on the electric railway over the Pyrenees between Villefranche and Bourg.—Madame M. **Dussaud**: Discontinuous sources of light. A commutator is fixed on to the mechanism of a kinematograph in such a manner that the lamp is extinguished during the time that a forward step is made by the film, the latter being only illuminated when stationary. The advantages of this arrangement are enumerated.—Jean **Becquerel**: Polarised phosphorescence and the correlation between the polychroïsm of phosphorescence and the polychroïsm of absorption. An account of experiments on the phosphorescence of rubies at low temperatures (the boiling point of nitrogen). A change in the orientation of the exciting rays results, not in a change in the state of polarisation of each line, but a variation in the intensity emitted, and this variation may vary from one line in the spectrum to another. These results necessitate a modification of the views previously admitted.—A. **Cotton** and H. **Mouton**: The absolute measurement of the magnetic double refraction of nitrobenzene. Comparing the method previously described by the authors and that of Skinner on the same subject, a source of error has been discovered in the latter, and, allowing for this, both sets of measurements are in good agreement.—Edmond **Bauer** and Marcel **Moulin**: The blue colour of the sky and the constant of Avogadro. According to a theory of Lord Rayleigh, the blue colour of the sky is due to the dispersion of sunlight by the molecules of the air, and from this theory an expression is deduced giving the Avogadro constant N (the number of molecules in the gram-molecule), in terms of the ratio e/E (brightness of the sky to that of the sun), the dielectric constant of the air, the apparent diameter of the sun, and other measurable data. The measurement of the ratio e/E is the most difficult, too large a value being found in the presence of large particles. An account is given of determinations of this ratio carried out in August, 1910, at the Vallot Observatory at the summit of Mt. Blanc. The weather was unfortunately unfavourable, but the figures obtained were of the same order as those of Rutherford and J. Perrin, based on different considerations. The results are favourable to Lord Rayleigh's theory.—A. **Lafay**: The inversion of the Magnus phenomenon.—F. **Michaud**: A capillarimeter for the measurement of the surface tension of viscous liquids. The capillary tube is bent at right angles, and the horizontal portion placed just under the surface of the liquid. The liquid is brought to a fixed mark on the horizontal portion by the pressure of an indiarubber ball, and the hydrostatic pressure then measured.—L. **Grenet**: The tempering of bronze.—M. **Barre**: The double sulphates formed by the sulphates of lanthanum and cerium with the alkaline sulphates.—J. **Taffanel**: Safety explosives employed in mines. An account of experiments carried out at the testing station of the Central Committee of French Collieries. The results obtained showed the importance of freeing the hole from coal-dust before fixing in the cartridge; that paraffined paper as an envelope for the cartridge produced injurious effects was also made clear by these experiments.—A. **Besson** and L. **Fournier**: The reduction of phosphoryl chloride by hydrogen under the influence of the silent discharge. The main reaction is the formation of the oxide P_2O, hydrochloric acid, and water.—Marcel **Delépine**: The action of pyridine upon the iridodisulphates.—G. **Guillemin** and B. **Delachanal**: Research on the gases occluded in the copper alloys. The metals examined included various kinds of brass, bronze, phosphor bronze, and tin, and the gases were only given up after fusion in a vacuum. Carbon dioxide and hydrogen were present in all the metals examined, methane and carbon monoxide being also present in the majority of cases.—G. **Darzens**: A new method for the preparation of the glycidic esters. Ethyl dichloroacetate and acetone react readily in benzene solution with magnesium, α-chlor-β-oxyisovalerianic ethyl ester being formed. From this the theoretical yield of dimethylglycidic ethyl ester is readily prepared in theoretical yield by treatment with sodium ethylate.—Gabriel **Bertrand** and G. **Weisweiller**: The constitution of vicianose and vicianine.—Ch. **Mauguin**: Liquid crystals in convergent light.—Méd. **Gard**: A hydrid of *Fucus platycorpus* and *F. ceranoides*.—Lucien **Daniel**: A perennial bean.—Jules **Amar**: The working of the human machine.—A. **Fernbach** and M. **Schœn**: The influence exerted by the reaction upon certain properties of malt extracts. The extracts were made neutral to different indicators, and the resistance to the effect of a rise of temperature and the increase in diastatic activity after keeping were measured.—L. **Launoy**: The toxicity of some mineral and organic compounds of arsenic: effect of repeated non-toxic doses.—Louis **Léger**: The muddy taste in certain fresh-water fish.—J. **Deprat**: The tectonic of Yun-nan.—Th. **Glangeaud**: The western edge of the Montbrison basin.—F. **Grandjean**: A measure of the lamination of sediments (limestones and schists) by means of the tourmaline crystals.

NEW SOUTH WALES.

Royal Society, June 1.—Mr. H. D. Walsh, president, in the chair.—G. H. **Knibbs**: Note on the influence of infantile mortality on birth-rate.—L. **Cohen**: The determination of alkali in arsenical dip-fluids.—Prof. A. C. **Haddon**: Note on Mr. L. Hargrave's paper, "Lope de Vega."—T. Harvey **Johnston**: Australian avian entozoa.—T. W. **Keele**: The great weather cycle.

July 6.—Prof. T. W. E. David, F.R.S., president, in the chair.—A. **Duckworth**: The respective limits of Federal and State legislation in regard to companies.—J. H. **Maiden**: Records of the earlier French botanists, as regards Australian botany.—Dr. W. G. **Woolnough**: Stone rolls, in the Bulli coal seam of N.S. Wales.—Dr. J. Burton **Cleland** and T. Harvey **Johnston**: Worm-nests in Australian cattle due to *Filaria* (*Onchocerca*) *gibsoni*, with notes on similar structure in camels.—T. Harvey **Johnston** and Dr. J. Burton **Cleland**: The anatomy and possible mode of transmission of *Filaria* (*Onchocerca*)

gibsoni.—C. F. **Laseron**: Palæontology of the Lower Shoalhaven River.

August 3.—Prof. David, F.R.S., president, in the chair.—A. **Duckworth**: White Australia.—Dr. J. Burton **Cleland** and T. Harvey **Johnston**: The hæmatozoa of Australian batrachians, No. 1. In this paper the authors give a list of frogs which were searched for the presence of hæmatozoa. In ten species, represented by thirty-four specimens examined, the results were negative, while in three species, represented by seven specimens, blood parasites were detected. A hæmogregarine, *Haemogregarina* (*Lankesterella*) *hylae*, infesting *Hyla caerulea* is described as new, and a trypanosome from *Lymnodynastes tasmaniensis* and *L. ornatus?* is regarded as being similar to, though probably not identical with, *Trypanosoma rotatorium*.—E. C. **Andrews**: An excursion to the Yosemite, or studies in the formation of Alpine cirques, steps, and valley treads. In a previous report (corrosion by gravity streams) the writer gave a general account of stream corrosion. In the present paper a more detailed account is given of the origin of the cirque, and the "steps" and "treads" of Alpine Valley. A special application of the principle put forward is made to the case of the Yosemite and associated valleys in California.—T. Harvey **Johnston** and Dr. J. Burton **Cleland**: A note on the occurrence of pentastomes in Australian cattle. In a short note the authors deal with the finding of larval pentastomes (*Linguatula serrata*) in the mesenteric glands of a number of cows in the Illawarra district. The hosts were all affected with endemic hæmaturia, and the discovery of these parasites suggests that they may perhaps play a rôle of much economic importance.—H. G. A. **Hardinge**: The condition of the atmosphere during the recent proximity of Halley's comet. Analyses were made of the atmosphere collected at an elevated locality in the neighbourhood of Hornsby about a week previous to the supposed date of contact (May 19) until a week following that event. There were no appreciable differences noted in the composition of the air during the whole of this time, neither did spectroscopic examination reveal any peculiarities.

Calcutta.

Asiatic Society of Bengal, November 2.—Panchanan **Neogi** and Birendra Bhusan **Adhicary**: Reactions in presence of nickel. (*a*) Inability of nitrogen and hydrogen to combine in presence of iron and nickel. (*b*) Reduction of the oxides of nitrogen, sulphur, and phosphorus in presence of nickel. Johnson showed that nitrogen and hydrogen combine directly to form ammonia in presence of heated spongy platinum. This was contradicted by Wright, who showed that the ammonia obtained by Johnson was due to the reduction of traces of nitric oxide contained in nitrogen. Ramsay and Young showed that traces of ammonia are formed by the direct combination of nitrogen and hydrogen in presence of red-hot iron filings. The authors show, however, that the two gases *do not* combine at all, provided the nitrogen is rendered absolutely free from nitric oxide and iron from carbon. It has also been shown that ammonia is not formed by passing the mixed gases over heated nickel. It is further shown that nitric oxide, sulphur dioxide, and phosphorus pentoxide are reduced to the corresponding hydrides by means of hydrogen in presence of reduced nickel. The mechanism of the reactions has also been studied.

DIARY OF SOCIETIES.

THURSDAY, November 24.

Royal Society, at 4.30.—On the Sequence of Chemical Forms in Stellar Spectra: Sir Norman Lockyer, K.C.B., F.R.S.—The Influence of Viscosity on the Stability of the Flow of Fluids: A. Mallock, F.R.S.—On Atmospheric Oscillations: Prof. Horace Lamb, F.R.S.—A Theory of the Chemical Action of the Electric Discharge in Electrolytic Gas and other Gases: Rev. P. J. Kirkby.—An Electrostatic Voltmeter for Photographic Recording of the Atmospheric Potential: G. W. Walker.—Optical Dispersion, an Analysis of its Actual Dependence upon Physical Conditions: Dr. T. H. Havelock.—The Spectrum of Halley's Comet: C. P. Butler.—A Geometrical Proof of the Theorem of a Double Six of Straight Lines: Dr. H. F. Baker, F.R.S.

Institution of Electrical Engineers, at 8.—Street Lighting by Modern Electric Lamps: H. T. Harrison.

FRIDAY, November 25.

Physical Society, at 5.—The Electric Stress at which Ionisation begins in Air: Dr. A. Russell.—The After-glow produced in Gases by Electric Discharge: Prof. the Hon. R. J. Strutt, F.R.S.—Exhibition of a Surface-brightness Photometer: J. S. Dow.—The Approximate Solution of various Boundary Problems by Surface Integration combined with Freehand Graphs: L. F. Richardson.

MONDAY, November 28.

Royal Society of Arts, at 8.—Industrial Pyrometry: C. R. Darling.

Institute of Actuaries, at 5.—Inaugural Address by the President: G. H. Ryan.

TUESDAY, November 29.

Royal Anthropological Institute, at 8.15.—Certain Physical Characters of the Negroes of the Congo Free State and Nigeria: Dr. A. Keith.—The Search for the Original Home of the Maori: A. W. Newman.

Zoological Society, at 8.30.—On a Possible Cause of Pneumo-enteritis in the Red Grouse (*Lagopus scoticus*): Dr. H. B. Fantham and H. Hammond Smith.—On the Alimentary Tract of certain Birds, and on the Mesenteric Relations of the Intestinal Loops: F. E. Beddard, F.R.S.—On the Specimens of Spotted Hyænas in the British Museum (Natural History): Prof. A. Cabrera.—The Development of *Solaster endeca* Forbes: Dr. J. F. Gemmill.

Royal Society of Arts, at 4.30.—The Progress and Prospects of Mining in Western Australia: A. Montgomery.

Institution of Civil Engineers, at 8.—*Further discussion*: Portland Cement, and the Question of its Aeration: H. K. G. Bamber.

WEDNESDAY, November 30.

Royal Society of Arts, at 8.—Argentina from a British Point of View: Campbell P. Ogilvie.

British Astronomical Association, at 5.

THURSDAY, December 1.

Linnean Society, at 8.—Spermatogenesis in Stenobothrus: Capt. C. F. U. Meek.—Reports on the International Botanical Congress at Brussels, 1910: Dr. Otto Stapf and others.

Röntgen Society, at 8.15.—Osmotic Growths: Dr. Deane Butcher.

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THURSDAY, DECEMBER 1, 1910.

HISTORY IN BRITISH PLACE-NAMES.

British Place-names in their Historical Setting. By Edmund McClure. Pp. 349. (London: Society for Promoting Christian Knowledge, 1910.) Price 5s.

THE loving labour of an average lifetime, "studies in leisure hours extending over some thirty years and more," this work is an eloquent testimony to the value of the science of philology in the elucidation of historical materials. It is both a history and a valuable guide to the philology of British place-names "as they occur chronologically in authentic historical documents from 54 B.C. until A.D. 1154." In his last paragraph, the author explains why he draws a line at Stephen's death.

"The consideration of later records containing place-names is not worth pursuing, as the forms therein presented vary but little from those now in use, and the new terms introduced by the continental monastic orders, such as *Beaulieu, Rievaulx, Jervaulx,* &c., explain themselves" (p. 304).

The phrase "not worth pursuing" surely needs some qualification, and the explanation offered implies that the author is satisfied that later documents contain no material additions to his list of historical place-names.

Very appropriately, "a short summary of the modern methods employed in linguistic research" is given at the beginning, to "illustrate the statement in the text and show the truly scientific character of comparative philology" (p. 13). The text is mainly a history of Britain with the place-names worked in, the latter elaborately discussed in "notes" and footnotes. The thoroughness, as well as the duration, of the author's studies are well attested by the numerous catenæ of name-forms. The best authorities on place-names are cited. Yet the author exhibits throughout a commendable critical independence, as well as personal detachment from pet theories, or theories one would have liked to press from personal conviction. When he discusses rival theories, as in the case of the Picts and their language, he gives a clear idea of the situation.

Considering the great advance made in philology and historical criticism in the last thirty years, such a work as this is must have been periodically revised to a large extent. Specialists in certain lines of inquiry would have expected further revision of some of the information given. The author betrays a suspicion of the genuineness of Gildas's "Destruction of Britain," the spuriousness of which has recently been demonstrated by Mr. Wade Evans and others. In the discussion of sites of battles fought by Arthur, no reference is made to Mr. Anscombe's clever elucidation of the place-names. Sir John Rhys is, of course, the most frequent witness in the author's court, but while the latest edition of the classic "Celtic Britain" has been consulted, no reference is made to that eminent scholar's contributions to the British Academy and the Cymmrodorion Society within the last seven years or so. The author's remark that "the nucleus of the work has already appeared in a serial" sufficiently accounts for the belatedness, in these expeditious days, of some sections of the work. Finality in a work of such a comprehensive design is out of the question, and such omissions as those noted above affect only very slightly the unquestioned usefulness of the work as it is.

The author seems to have a very firm grip of the Scandinavian element in British place-names, a subject which is coming more and more to the fore. In his discussion of the place-names of Shetland and the Orkneys, which are "almost exclusively Scandinavian" (p. 227), the author leaves an impression that he is unwilling to go as far as his evidence goes, and one's attention is arrested by a doubtful deduction.

"As *Orkn* in Norse means a seal, Orkn-eyjar would seem a natural designation for these islands, but the term *Orc* in Orcades goes back to classical times, long before a Northman had put his foot upon them, and its meaning must be sought in the language of the earliest inhabitants" (p. 225).

The facts cited favour a theory of a very early occupation of the Orkneys by Scandinavians, and other evidence may be adduced to the same effect, but all that evidence must be laid aside, because the author is satisfied with some late date for such occupation, and with "classical" spellings of place-names in Britain. On general grounds, alleged dates of the beginnings of great racial migrations are open to a reasonable suspicion, and "classical" references to places in Britain cannot be accepted as final as against overwhelming local evidence.

The perusal of this scholarly, yet readable, book, in which history and philology are made to eludicate each other, opens up a vast field of inquiry, in which archæology, anthropology, and astronomy should also be requisitioned. We have given us an estimate of the value of documentary place-names. A companion volume on the documentary value of place-names in current use, or unrecorded in the documents examined by the author, would be very acceptable. The book is a marvel of compression, and an index of forty-five pages makes it a most welcome work of reference.

JOHN GRIFFITH.

THE CHEMISTRY OF THE ALKALOIDS.

Die Alkaloide. By Prof. E. Winterstein and Dr. G. Trier. Pp. vii+340. (Berlin: Gebrüder Borntraeger, 1910.) Price 11 marks.

SINCE Derosne and Sertürner isolated morphine, the crystalline principle of opium, about a century ago, the separation of the natural bases from plants has always taken a prominent place in chemical research. To-day the number of these substances exceeds two hundred, and the list is probably far from complete. The process of their isolation is usually accompanied by a study of their therapeutic value and by the more difficult and fascinating task of discovering their structure. Of the pioneers in this branch of chemistry, A. W. Hofmann stands in the forefront. Following the earlier discoveries of Gerhardt on the relation of the pyridine bases to the alkaloids, he was able by the aid of new and ingenious methods of dis-

integration, to identify many of the products with derivatives of these bases. But, as the authors of the above monograph state :—

"The constitution of an alkaloid cannot be regarded as definitely ascertained until it has been artificially prepared in accordance with the formula and identified with the natural product."

It is this last synthetic process which calls for the utmost resource and skill of the experimenter. The success which accompanied Hofmann's researches only served to emphasise the difficulties of the final synthetic stage. In spite of the magnitude of the task, Ladenburg accomplished the complete synthesis of coniine (the active principle of hemlock) in 1886. This was followed by Hantzsch's synthesis of trigonelline in the same year, and of piperine by Ladenburg in 1894. Perhaps the most brilliant of recent achievements in this region of research are the syntheses of the tropine alkaloids (atropine, cocaine, tropacocaine) by Willstätter, laudanosine, papaverine, and nicotine, by Pictet, and the purine bases by E. Fischer.

As it is improbable that any known alkaloid exceeds in complexity those the synthesis of which has been accomplished, it may be safely predicted that sooner or later all will be produced artificially. Interesting as this record is of past results and future promise, the real significance of these discoveries is much more far-reaching; for the peculiar physiological properties of the alkaloids has led directly to the study of the relation of atomic grouping to physiological action. The ceaseless activity which has been displayed in this direction, especially in the German laboratories, has thrown so much light on the subject that new drugs are constantly produced the therapeutic action of which closely imitates that of the natural product. This vast and ever-increasing mass of new observations has already been carefully compiled in a treatise by Pictet, and in several monographs by Schmidt.

With the exception of one chapter on the source and significance of the alkaloids in plant-life, to which reference is made below, there is nothing in the present volume which can be said to supersede those named. Like the latter, it is a compilation of the more important facts systematically arranged and brought up to date; but there is no attempt at literary embellishment, which renders Pictet's book so readable, nor are those full references given, which are indispensable in a book of this nature, and form so important a feature in its predecessors. The concluding chapter on the origin of the alkaloids in the plant is the most interesting in the book, not because it throws much new light on the problem, but rather because it reveals the enormous difficulties which surround it. The authors rely on the proteins for their raw material, which, it is well known, contain no pyridine, quinoline, or isoquinoline constituent. For these nuclei they have recourse to such protein products as lysine and arginine, which can conceivably be fused into rings and bring to their aid formaldehyde, and its reduction and oxidation products, methyl alcohol, and formic acid for further elaborating these simpler ring compounds. Theorising is a necessary part of every progressive science, and no fault need be found with the authors if they like to exert their ingenuity on so fascinating a theme. At the same time, it may be pointed out that, if protein materials are to be taken as the starting point, the origin of such compounds as tyrosine and tryptophane affords difficulties quite as great as those which surround the natural synthesis of the alkaloids.

J. B. C.

PRACTICAL GARDENING.

Manual of Gardening. A Practical Guide to the Making of Home Grounds, and the Growing of Flowers, Fruits, and Vegetables for Home Use. By L. H. Bailey. Pp. xvi+539. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1910.) Price 8*s.* 6*d.* net.

PROF. BAILEY is already very well known to readers in this country as the author of numerous works upon various branches of scientific horticulture. His greatest work is a "Cyclopædia of American Horticulture," in several large volumes, and containing an immense amount of information on American garden plants, contributed by a large number of specialists. The present work, though far less ambitious, will be found extremely useful to gardeners in the States, even to those with very little experience, for the author, specialist as he is, finds no difficulty in writing upon garden subjects in a manner easily understandable by amateurs.

In a large measure the work is a combination and revision of two former volumes, "Garden Making" and "Practical Garden Book," and it constitutes a guide to the making of home grounds, and the growing of flowers, fruits, and vegetables for home use.

Gardening in the States is not so general or technical as it is in our own country, and most of those who attempt to practise it find a great difficulty at the very outset, for they have few good models available to inspire them with correct ideas. In a large number of instances the formal method of design and planting is given preference, and the ordinary formal garden in America has most of the blemishes such gardens possess at home, but few of the virtues that characterise this system of landscape gardening at its best. There are certain instances of first-rate formal gardening in America, but, as the author of "The American Flower Garden" pointed out recently, the public has seldom the opportunity to inspect them.

Prof. Bailey's advice on the formation of gardens is therefore very opportune, for whilst he does not show himself as a partisan of either of the opposed methods, he explains carefully and in great detail how to make the best use of both by adopting them to the special circumstances of site, aspect, altitude, soil, and climate. Having discussed the "point of view" with regard to laying out the garden and planting it, the author proceeds to relate in detail the treatment of the more important species of plants. The chapter on the protection of plants from things that prey upon them (pests) is unusually valuable, for Prof. Bailey has a rare experience of the subject. Chapters ix. and x. deal respectively with fruit and vegetables, and on these subjects cultural details are supplied on almost every crop. The crops are much the same as

our own; indeed, the fruit crops are identical, whilst all our well-known vegetables are included amongst those cultivated in America, but there are some which are not familiar to us, including such as the sweet-potato, Rutabaga (a kind of turnip), watermelon, pepper, and okra. The okra is a plant belonging to the cotton family, and the green pods are used for making the well-known gumbo soup common in the southern States. The pods are also used for stews, and they are preserved by drying for use in winter.

The book concludes with a chapter containing cultural reminders for every month in the year, both for the northern and southern States, the requirements differing somewhat widely owing to the great differences in the climate.

The volume is freely illustrated, and it contains twenty-five plates which are reproductions from photographs. Beyond these there are numerous illustrations in the text, most of them from sketches, and, taking them generally, they are very inferior, the figures of apples and other fruits being particularly inadequate and disappointing.

A TREATISE ON BRITISH NUDIBRANCHIATE MOLLUSCA.

A Monograph of the British Nudibranchiate Mollusca, with Figures of the Species. Text by Sir Charles Eliot, K.C.M.G. Figures by the late Joshua Alder and the late Albany Hancock and others. Part viii. (Supplementary). Pp. vi+197+8 plates. (London: The Ray Society and Dulau and Co., 1910.) Price 25*s.* net.

THIS "supplement" to a work issued half-a-century ago has been admirably conceived and written by the Vice-Chancellor of Sheffield University. Alder and Hancock's classic monograph is known to every marine zoologist, and fifty years of research and criticism have found scarcely one weak place or error in that accurate and beautiful treatise. The authors, however, had accumulated certain addenda which they would probably have eventually published in the present form of a supplement. They knew that certain of their descriptions were not sufficiently full or were not based on a sufficiently large number of specimens to be final. Moreover, two generations of zoologists could scarcely fail to add new forms to a fauna that was published between 1845 and 1855, or to discover new points in the natural history and anatomy of these attractive mollusca. Hence the need for the present volume, and hence its matter. The illustrations are largely drawn by Alder and Hancock, and have been kept, in the long interval since they were made, in the Hancock Museum at Newcastle-on-Tyne. Sir Charles Eliot has had them reproduced and added to. His long and extensive acquaintance with the subjects and its literature in many lands has qualified him to write a text that shall worthily compare with that of the seven previous parts. The result is one upon which the author and the Ray Society may be warmly congratulated.

Few occurrences make such a pleasurable impression upon a zoologist as one's first encounter with a member of this group of animals. On turning over a stone from the heap that lies covered by laminarian fronds, a grey, slimy object disengages itself from the rich animal undergrowth, and on transference to a vessel of water, straightens out its foot, erects its sensitive "feelers," and waves its serried "cerata." The slimy blob has become a superbly coloured eolis, or an *Aegirus punctilucens,* with coloured light emanating from the sparkles on its mantle. Such a transformation is not readily forgotten, and when the attraction of nudibranchs has once been felt, it is not easy to resist the temptation to investigate so many of these creatures as can be examined in a state of nature. The search for them takes one into the rich pastures of the sea, and here they must be found only by acquaintance with the special haunts of each several kind. The sea, like the land, has its seasons of plenty and of poverty. In winter and early spring few nudibranchs are to be found in the laminarian beds, where later they will abound. A few Doris, perhaps, no two alike in colouring, and an *Eolidia papillosa,* may be found gnawing the base of a sea-anemone or winding that pink gelatinous band of eggs which is to people the water with quaint free-swimming larvæ. But as spring comes, the nudibranchs increase in number, and proceed at once with the great business of procreation. The hydroids, sponges, or alcyonium are the special resorts of Doto, Doris, and Tritonia. Others affect sea-weeds, and are scarcely to be detected in the axils of their food-plant. One kind, a glutton, is found only on the eggs of certain fish. Another eats out the soft parts of a sea-squirt, and then lies buried in the eviscerated tunic. Altogether in the British area there are more than a hundred species, a synopsis of which forms the last portion of this work.

The mode of treatment may be shortly summarised. First comes a chapter on variation and distribution. In colour particularly nudibranchs offer a considerable range of variation, in part due to food, in larger part to light-factors that have as yet not been examined. Age differences between individuals of the same species introduce another source of diversity, and the phenomena of autotomy among Eolids is a further cause of discrepancy. With regard to distribution, Sir Charles Eliot summarises a great mass of evidence in a few pages. The most salient facts are the similarity of the nudibranch faunas in the northern and southern parts of the Atlantic, the similarity of the nudibranchs in the North Atlantic and North Pacific Oceans, and the distinctness of a tropical fauna in the intermediate zone.

"It is interesting to see that the waters of the South Atlantic beyond the tropics contain forms very similar to those found in the north, if not identical with them" (p. 11).

Eolids appear to be preponderant in Arctic and Antarctic waters, Doris in tropical waters. With regard to the vexed question of nomenclature, Sir Charles takes up a position intermediate between the "lumpers," such as Alder and Hancock, and the "splitters," such as Bergh, and he has many valuable remarks on the synonymy of the more difficult species. Two interesting chapters follow on the bionomics and

development of the group and on the anatomy of Doris and of Æolidia; whilst the questions of classification, affinities, and descriptions of species occupy the latter half of the work. On these sections, the author's intimate knowledge of his subject confers a philosophic caution and breadth of treatment. Attention may be directed especially to the discussion of the relations existing between nudibranch and tectibranch mollusca (pp 89–92), and to the descriptions of fifteen species not described in the monograph. Malacologists are under a great debt to Sir Charles for this fine work, which is worthy of the classic that it supplements.

F. W. G.

WILD FLOWERS.

Wild Flowers of the British Isles. Illustrated and written by H. Isabel Adams. Revised by James E. Bagnall. Vol. ii., order xlii., Campanulaceæ to order lxxxvi., Araceæ, completing the British Wild Flowers with the exception of Water Plants and Trees. Pp. xi+199. (London: W. Heinemann, 1910.) Price 30*s.* net.

THE talented author of the volume under review has made the fatal mistake of attempting to serve two masters, and with the inevitable result. From the artistic point of view the plates are for the most part very good, and they combine accuracy of detail with beauty of arrangement. No doubt they have suffered somewhat in the process of reproduction by the three-colour process, especially as regards the green tints, but the original drawings must be excellent. An attempt has been made to produce a British flora of an up-to-date character, based on the last edition (10th) of the London catalogue, and also to produce an illustrated flora. The work before us is incomplete from both points of view.

As a flora the omission of trees, referred to on the title-page, is a great mistake, but the complete neglect of Juncaceæ, Cyperaceæ, Gramineæ, and other monocotyledonous natural orders, without a word of explanation, deprives the book of any real scientific value. "Water plants" are also said to be excepted, as well as trees, but the definition of a water plant adopted by the writer must be individual and peculiar since *Hottonia palustris, Nymphoides* (*Villarsia*) *peltatum, Lobelia Dortmanna,* and others are not only included but illustrated. It is not easy to suggest any reason for the omission of other natural orders not specifically referred to, such as Elæagnaceæ and Loranthaceæ. There can be no question that both sea buckthorn and mistletoe are "wild flowers of the British Isles"; the former might be ruled out of court as a tree, but its claim to inclusion is a strong one when the non-British *Lycium chinense* forms the subject of a well-executed drawing. The common privet, too, is scarcely a tree. Plantains also, wild flowers *par excellence* and decorative also, fail to find a place in the volume, and one is tempted to conclude that certain plants do not find favour with the writer. It is not a case apparently of the weakest going to the wall or of suffering minorities, since other natural orders with only one or two genera are to be found in their proper place.

The descriptions of the various species are on the whole well drawn up, and some interesting general information is given under each natural order. An attempt is made in some orders to make a slight key to the genera and species, but unfortunately for the unlearned student the keys are not very helpful. In the Labiatæ, for instance, the contrasted heads of the key have no logical sequence. They run as follows:—

> Corolla, 2-lipped, and usually 5-lobed.
> Stamens 4, 2 outer longer.
> Stamens 4; calyx-tube with 10–13 ribs.
> Calyx 2-lipped, closed in fruit; stamens included in upper corolla-lip.
> Corolla bell-shaped, with 4 nearly equal lobes; calyx with 5 equal teeth.

There appears to be no reason from such a key why one genus should be placed under one heading rather than under another.

Enough has been said to show that this book cannot rank as a valuable contribution to the science of botany, and it is all the more to be regretted when the excellence of the drawings is considered. Although in some of the plates there is unnecessary crowding, yet the draughtsmanship throughout is of a high order, and the plates of Convolvulus and *Tamus communis,* to mention two only, are beautiful works of art. A complete series of plant pictures of our British flora by Mrs. Adams would be of considerable value, and it is a matter for regret that so much skill and labour should have been expended on a book so pretentious and incomplete, which, with all its accuracy of drawing, unfortunately can only be regarded as a work for the drawing-room table.

SHALLOW-WATER STARFISHES.

Echinoderma of the Indian Museum. By Prof. René Koehler. Part vi., Asteroidea (ii). An Account of the Shallow-water Asteroidea. Pp. 191+xx plates. (Calcutta: Printed by order of the Trustees of the Indian Museum.) Price 20 rupees.

IN this carefully executed and copiously illustrated memoir the starfishes of the Indian littoral are for the first time regimented, from material collected, between the Persian Gulf and the Malay Peninsula, during thirty years of steady work, by the Royal Indian marine survey-ship *Investigator,* supplemented by local contributions from the recently commissioned Bengal Government Fisheries' steamer, *Golden Crown.*

Sixty-seven species are enumerated, of which twenty-eight are described as new. Among the novelties, though there is nothing very surprising, the species of Astropecten, Anthenea, Goniodiscus, Nardoa, Luidia, and Ophidiaster predominate.

Of old-established species several that were insufficiently characterised by their authors, or that have never been figured, are here re-described with infinite care, or interpreted by wonderfully lucid photographs, according to the requirements of each case, the author having taken the trouble to rivet attention on nothing less authentic than the very "types." This method of work, together with the fact that certain genera—

particularly the by no means easy genus Pentaceros—are practically revised, within set geographical limits, adds enormously to the value of this conscientious monograph.

Though the work is for the most part descriptive—almost commendably so in an age of easy speculation—the author takes pains to set all his species in their due relations. Of *Palmipes sarasini* he observes that its differences from its congeners are almost of generic value, and of Valvaster that its peculiarities are almost sufficiently exclusive to give it rank as an independent family. He also discusses the position of the irreconcilable genus Metrodira, which he has no hesitation in establishing among the Linckiidæ. Nor has he forgotten to notice the small parasitic mollusca found on species of Stellaster and Palmipes.

This is Prof. Koehler's sixth memoir of the fine collection of Echinoderms of the Indian Museum, and, as India is still *meta incognita* so far as the Echinoidea are concerned, we trust that it is not the last.

One criticism, however, may be offered of this memoir, as of its precursors of the series, namely, that it is too exclusively addressed to the specialist. Species are examined and described with acumen, but there are none of those synoptical tables, of educational value, which the student has almost a right to expect in a museum publication that treats in its entirety one large component of a fauna. If the author would crown his labours in this field by publishing synopses of the families, genera, and species of Indian Echinoderma, he would "thereby highly oblige" many to whom, though they are not experts, whatsoever passeth through the paths of the seas is of interest.

EXPERIMENTAL ELECTRICITY AND MAGNETISM.

(1) *Practical Electrical Engineering for Elementary Students: An Elementary Laboratory Course for Students of Electrical Engineering in Trade and Technical Schools.* By W. S. Ibbetson. Pp. xii+155. (London: E. and F. N. Spon, Ltd.; New York: Spon and Chamberlain, 1910.) Price 3*s*. 6*d*. net.

(2) *Practical Electricity and Magnetism: A First Year's Course.* By R. Elliott Steel. Pp. viii+175. (London: G. Bell and Sons, Ltd., 1910.) Price 2*s*.

(3) *Elementary Experimental Electricity and Magnetism.* By W. T. Clough. Pp. viii+255. (London: Methuen and Co., Ltd., 1910.) Price 2*s*. 6*d*.

THE first two books are intended to cover first-year laboratory courses, in the one case for technical students, in the other for beginners in science at a school or college. The usual differences are to be noted between them, the second being far more theoretical than the first, and also containing sections on magnetism and electrostatics, which the other does not touch.

(1) The system employed by Mr. Ibbetson is excellent, and could with advantage be adopted in any technical schools in which a similar scheme is not already in operation. It is perhaps to be regretted that no experiments with magnets are included, unless the student is intended to have taken a preliminary course in electricity and magnetism under the heading of physics.

Slight alterations in the experiments will have to be introduced in different laboratories to suit diverse conditions, as the book has evidently been written to fit the apparatus employed in one particular school. This defect shows itself most prominently in the too narrow specification of the instruments to be used in the experiments, instead of general advice to enable students to select instruments and resistances suitable in their range and capacity.

The connection diagrams are, on the whole, very good, the boldness of their drawing being a valuable feature. They could be improved, however, especially in the cases of more complicated experiments, by simplification of the drawings of instruments and switches and the avoidance of cross-overs wherever possible.

In experiment xxxv. the use of a standard resistance in connection with the calibration of a voltmeter seems quite unnecessary, and confuses the experiment with the calibration of an amperemeter.

"Shunt dynamo, separately excited," is a very contradictory term, which appears on p. 144; moreover, the experiment can be performed just as well with a generator with a low-resistance field winding.

The complete lack of any reference to the error due to the voltmeter current when measuring resistance by the ammeter-voltmeter method is a serious defect. When measuring efficiency in the photometry experiment, the connections are made so as to avoid this error, but no reason is given. On the whole, however, the experiments are detailed with the care and exactness so essential when dealing with elementary classes.

(2) Mr. Steel's book contains instructions for carrying out a great many experiments, but the language is hardly concise enough for scientific work. The use of supply mains and accumulators is avoided, which renders the book suitable for some few laboratories but unsuitable for many others. The comparative absence of diagrams of connections is a great drawback, and the few which appear are not good examples for students to copy from.

(3) Mr. Clough's book is intended to act as a theoretical text-book, as well as a practical guide in the laboratory, for students preparing for the elementary examinations in the subject.

Magnetism and statical electricity together occupy the first one hundred and fifty pages of the book, and voltaic electricity the remaining one hundred. Voltaic work is explained from a statical point of view in a method somewhat unusual at the present day.

The diagrams and illustrations are plentiful, and the type is varied so as to call into prominence the most important passages. Numerous exercises are given, chiefly drawn from recent examination papers, which should be very helpful for intending candidates.

A few omissions are noticeable, *e.g.* no reference is made to the moving-coil type of galvanometer, which is more frequently used than the suspended-magnet type.

OUR BOOK SHELF.

The Calculus for Beginners. By J. W. Mercer. Pp. xiv+440. (Cambridge: University Press.) Price 6*s.*

STUDENTS of ordinary endowment form the habit of observing things before words. The author of this work has therefore wisely begun with the notions of velocity and gradient of a curve before introducing dy/dx as the instrument for measuring them. The purely mathematical aspect of a limit is not omitted, but it is subordinated; the need for it precedes its introduction. For many purposes, and at any rate for initial study, this course is quite satisfactory; and the author will find most teachers in agreement with him in thinking it is also wise even for those who are to proceed to the more severe and formal study of the calculus. While he doubtless recognises that physicists, engineers, and chemists would benefit by finally surmounting the difficulties of the notion of a limit, he does not make it his business in this book to give the first importance to the difficulties of analysis presented by his subject.

The ground is covered slowly at first; some 250 pages are devoted to the case of x^n in all its bearings before $\sin x$, $\cos x$, a^x, $\log x$, &c., are discussed, even the rules for the differentiation of a product and quotient being postponed until the student is well on with the subject. Those who think that this is a large allowance of pages to the earlier part of the calculus should remember that the shortest account of a mathematical doctrine is not necessarily the one which occupies the fewest pages. An excellent feature of the treatment is the introduction of integration under the heading, "Given dy/dx, find y." The student cannot have it impressed upon him too soon that the determination of a function is often most easily carried out by first finding the rate of variation of the function. In his graphical work he has probably often observed this rate of variation, so that the notion has more chance of appearing *exact* than that of the limit of a sum, and he has at the same time the advantage of getting the most out of the newer ideas with which he has become acquainted. The introduction of e^x graphically is the necessary outcome of the author's whole method, and will give a conviction that seldom if ever results at first from the complete algebraic treatment.

The work, which is well supplied with diagrams, is certain to be used by many teachers, who will find it well adapted to meet the requirements of those for whom it is written.

A Text-Book of Organic Chemistry. By Prof. A. F. Holleman. Edited by Dr. A. Jamieson Walker, assisted by Owen E. Mott. Third English edition, partly rewritten. Pp. xx+599. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1910.) Price 2.50 dollars.

THE first edition of this book was reviewed in the columns of NATURE in 1903, and we were impressed with it as being a most useful addition to the books in English on organic chemistry. Since then we have recommended it to students, who have found its study both interesting and useful. Evidently the book has filled a want in the country, as a second edition was published in 1907, and now we have before us the third edition.

Considerable additions have been made in this issue owing to the advances in organic chemistry which have taken place. The chapter on proteins has, for example, been rewritten, and is now incorporated with the general scheme of the book, whereas in the first two editions the proteins were placed in the appendix. Furthermore, the translator has introduced the protein classification adopted by the Chemical Society, which, of course, is a great advantage to English readers. Another chapter which has been enlarged and completely rewritten is that on pyrrole.

In reading through the book one continually comes across small alterations, sometimes considerable alterations, where recent advances have shown the necessity for revision or additions. For the purpose of review, it is not necessary to direct attention to each alteration or addition; it is more to the point to remark that the book has been carefully revised and brought up-to-date, and that the high standard of the work has been maintained in the third edition. It is to be thoroughly recommended as putting in a succinct and readable manner the salient facts of organic chemistry. The book is not exhaustive, but the student who has carefully studied it will be in a position to read with understanding and discrimination larger works on the subject, which, without the previous knowledge obtained from this work would be beyond him.

F. M. P.

A Popular Guide to the Heavens. By Sir Robert S. Ball, F.R.S. Pp. xii+96+83 plates. (London: G. Philip and Son, Ltd., 1910.) Price 15*s.* net.

THERE appears to be little difference between the present book and the second edition, issued in 1905, and reviewed in NATURE of March 9 of that year (vol. lxxi., p. 437). The number of plates and descriptive text is the same, but a frontispiece has been added, giving reproductions of drawings of the miner's comet (1910*a*) and Halley's comet.

We must express astonishment that this "Popular Guide to the Heavens" should contain no reproductions of the remarkable photographs of solar faculæ and flocculi taken by Hale, Deslandres, and others in recent years. These pictures are among the most striking illustrations of celestial phenomena ever produced; yet no notice is taken of them in plate or text. The sun is represented by two plates, one showing a large sun-spot and the other some great prominences. We suggest that it would be far better not to illustrate solar phenomena at all than to let these two plates be considered to represent the most interesting pictures of modern solar physics.

The book contains many beautiful pictures and valuable maps, and is altogether an attractive volume, but there is no reason why people who possess the second edition should purchase the new issue with the view of finding further illustrations of astronomical progress.

Catalogue of Hardy Trees and Shrubs Growing in the Grounds of Syon House, Brentford. By A. B. Jackson. Pp. x+38. (London: West Newman and Co., 1910.)

THE unique collection of trees and shrubs in the grounds of Syon House, Brentford, the Middlesex seat of the Duke of Northumberland, has not been catalogued within the last sixty years, during which time there have been many changes, as specimens have died off and new species have been introduced. The chief interest lies in the fine old trees, some of which are the best representatives of their kind in the kingdom. Two black poplars, estimated to be 128 feet high, are the tallest, and an elm is about 9 feet shorter. More unique are a specimen of *Liquidambar styraciflua* that exceeds 91 feet, and a *Catalpa kaempferi* approximating to 58 feet in height. The collection of deciduous cypresses, *Taxodium distichum*, showing the so-called knees, are famous, and have been frequently described; some fine specimens of *Zelkova crenata* (Urticaceæ) are remarkable. The items of information consist, so far as is possible, of popular

name, family, situation in the garden, country of origin, and date of introduction; interleaved blank pages are provided for notes and additions. The author is to be complimented on the accuracy of his work.

The Essentials of Histology, Descriptive and Practical, for the Use of Students. By Prof. E. A. Schäfer, F.R.S. Eighth edition. Pp. xi+571. (London: Longsmans, Green and Co., 1910.) Price 10s. 6*d*. net.

WHEN Prof. Schäfer's "Essentials" made its first appearance some years ago it was at once recognised that here was the book which had long been wanted, and it has since then continued to occupy the foremost place in the estimation of both teachers and students. Every successive edition has kept the work fully up to date in regard to practical methods, descriptive letterpress, and last, but not least, illustrations. Any extended notice of such a well-known text-book is quite unnecessary; all one need say of the eighth edition is that it fully maintains the high standard of previous editions, and the author is to be congratulated on the continued and well-deserved popularity which it has obtained. W. D. H.

The Charm of the Road. England and Wales. By James J. Hissey. Pp. xviii+426. (London: Macmillan and Co., Ltd., 1910.) Price 10s. net.

IN his latest book, Mr. Hissey is as successful as ever in painting the charms of travel in one's own country. The journey described in the present volume was begun without a premeditated plan; the author says:—"To us the destination was a trivial detail, left to settle itself each day; the joy of the journey was the thing, therein our pleasure lay." Certainly Mr. Hissey's gossipy description of the places and scenes they met with, and the quaint experiences they were fortunate enough to have, is more than sufficient to convince the reader that the fortunate possessor of a motor-car, a pleasant companion, and plenty of leisure, can have an excellent holiday indeed in straying from one shire to another, as fancy dictates.

The excellent photographs which illustrate this interesting travel book are good testimony to Mr. Hissey's keen eye for the beautiful and picturesque.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Marine Microthermograms and the Influence of Icebergs on the Temperature of the Sea.

THE application of precise temperature measurements to the determination of the formation and disintegration of ice in the St. Lawrence River suggested to me the possibility of using very delicate electrical thermometers on shipboard to determine the proximity of icebergs. On account of the difficulty of the experiments, and the fact that well-known authorities on navigation (including Lord Kelvin) had reported that temperature measurements were likely to be uncertain, except when very close to a berg, it was some time before I could arrange for the necessary trials.

In the meantime I had devised a practical form of electrical microthermometer, which was given a thorough test on board the Canadian Government ice-breakers during the experiments made last winter to keep the river clear of ice above Quebec. So sensitive and precise did this instrument prove, that a uniform temperature gradient in the water of one-tenth of a degree per mile could be determined from the ship, approaching an ice field from open water, to an accuracy of a thousandth of a degree.

The interesting experiments of Prof. Otto Pettersson on the influence of ice on oceanic circulation, described in the *Geographical Journal* for 1904 and 1907, made it appear highly probable that the experiments I wished to try would prove successful. Dr. Pettersson showed that ice melting in salt water produced two cold currents, one of fresh water which flowed out on all sides over the surface of the sea, and one of salt water which sank down by the ordinary laws of convection. A third current of warmer sea water flowed in towards the ice, under the surface, and produced the melting of the ice.

Through the kindness of the Hon. L. P. Brodeur, Canadian Minister of Marine, passage was secured on the

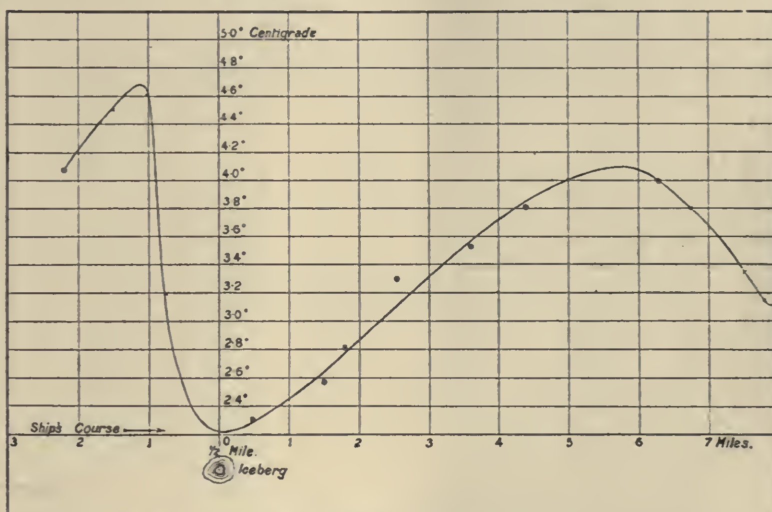

FIG. 1.—Temperature Gradient near an Iceberg.

C.G.S. *Stanley* for the trip to Hudsons Bay last July. As other duties prevented me from being absent from Montreal for so long a time, I was fortunate in being able to send Mr. L. V. King, who had so ably assisted me during the previous winter in ice studies, and who had gained great facility in using the microthermometer.

In addition to the ordinary wire bridge which we used in our river experiments, having a scale nearly 2 feet long for one degree, we adapted a Callendar recording mechanism to our needs, which gave us a scale of 1° C., equal to 8 inches. The automatic recorder could be switched on to the microthermometer at any time, and records accurate to one-hundredth of a degree obtained at any part of the temperature scale. They were obtained while the ship steamed at full speed through heavy seas, and were unaffected by the motion.

I venture to show two diagrams from the many Mr. King obtained, which illustrate the disturbing effect of ice on the temperature of the sea in summer. Fig. 1 shows the temperature gradient approaching and receding from a large iceberg passed within a half-mile from the ship in the open sea off the Labrador coast. The ship's course is shown relative to the iceberg. Fig. 2 shows a microthermogram of sea temperature traced directly from the charts. The proximity of ice is at once shown by a movement of the pen of the recorder off the scale, to return again to approximately the same position after the

iceberg is passed. In nearly every record we have there is a small rise of temperature above the surrounding sea temperature before the fall occurs, which seems characteristic of an iceberg effect.

In the light of the microthermograms we have obtained, the usual method of taking temperatures at sea seems decidedly inadequate. Thus, even if temperatures are taken over the side of a moving ship every fifteen minutes, readings are obtained at about two- to three-mile intervals, which obviously cannot be of much value in determining the temperature gradient characteristic of an iceberg. They might easily, as some of our charts show, indicate a rising rather than a falling temperature. The ordinary marine thermometer, with a degree one-eighth of an inch long, would miss entirely temperature effects made perfectly plain by the microthermometer. The persistence of a temperature gradient in the direction of a ship's course is one thing which I think can be relied on to give iceberg warnings, but when the whole temperature drop is

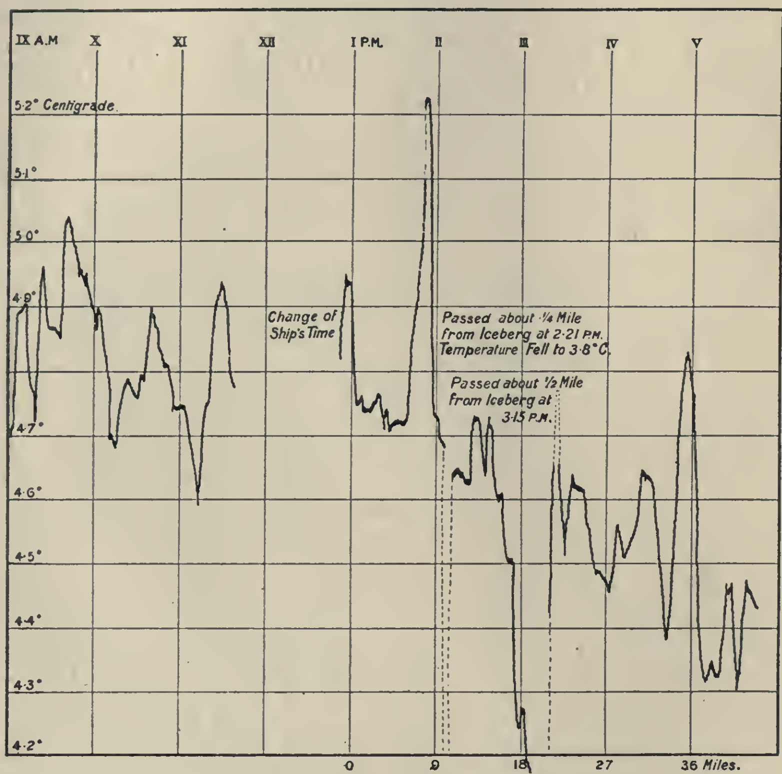

FIG. 2.—Microthermogram of the Temperature of the Sea.

fewer than two degrees in six miles it is evident that very sensitive thermometers must be used to detect it.

Besides the disturbing influence of ice, the proximity of land within a few miles produces effects of great magnitude as compared with the remarkably small variations of temperature in the open sea. In our case this was, no doubt, caused by the cold under-currents being turned up by the shoals and shore line of the Labrador coast.

For hydrographic work, the determination of current boundaries could be made with great exactness from a comparison of the temperature traces and the determination of ship's position.

The small inequalities in the temperature of the sea stand out in strong contrast to the uniform temperature of the St. Lawrence River just after the ice has moved out in the spring. These inequalities of temperature suggest at once the possibility of a vertical circulation set up by convection currents, which must be an important factor in the retention of the solar energy absorbed by the sea. It explains why our records of air and sea temperatures show no diurnal variation, except in the former case when near land. It seems to be well known to biologists that small temperature variations in the sea may be set up by the existence of marine life, and it is difficult to think of any other cause for what we have observed. It is interesting as indicating how important a part marine life probably plays in the conservation of solar energy.

H. T. BARNES.

McGill University, October 27.

Dun Coat Colour in the Horse.

MY attention has been directed to a letter in NATURE of November 24 over the signature of Prof. J. Wilson. He disputes the accuracy of certain extractions from "The General Stud Book," which originally appeared in *The Veterinary Record*, in my paper on the inheritance of dun coat-colour. Prof. Wilson also states that in the Stud Book entries there is a considerable element of doubt. This would appear to be the usual attitude of his mind in relation to data which do not exactly fall in with his own theories.

Let me first take the case of the mare Silverlocks (foaled 1725). I most emphatically deny that "the Stud Book assumes" that this mare, which is described as a chestnut on p. 1, vol. i., is identical with a mythical chestnut mare which Prof. Wilson says was foaled exactly a hundred years later. The animal to which he probably alludes was foaled in 1824, and is entered in the third volume as a "*bay colt Silverlock*," by Blacklock out of Sheba's Queen. I would direct Prof. Wilson's attention to the fact that the chestnut mare Silverlocks (1725) is the only *mare* of that name in the first four volumes of the Stud Book, and that the Stud Book entry is perfectly authentic, since it was extracted from an early Racing Calendar which describes Silverlocks as a chestnut mare by The Bald Galloway, out of a sister to Chaunter. This mare was raced for some years, and there is no room for doubt that she was the dam of the dun colt Buffcoat, foaled 1742, and of his two dun sisters, foaled in 1738 and 1739 respectively, all three being by The Godolphin Arabian (brown or bay). Does Prof. Wilson mean to imply that Lord Godolphin was so dishonourable as to run Buffcoat under a false pedigree, for that in effect is what he would have us believe? I have already directed his attention in a private letter to the circumstance that I have a portrait of Silverlocks (1725) which shows her an unmistakable chestnut, and not a dun.

In regard to the dun filly Sarah Curran (1892), by Robert Emmett (bay or brown), out of Cellulites (black), Prof. Wilson is certainly misleading, for he fails to disclose the fact that Messrs. Weatherby distinctly state in vol. xviii., p. 727, that "this mare erroneously appeared in the last volume as dead." Now, whether Prof. Wilson likes it or not, the breeder of Sarah Curran, Mr. J. T. Hartigan, returned this mare as a dun. I judge he was in a better position to form an opinion concerning her pedigree and colour than my critic, who never saw her.

Prof. Wilson says that the filly (1886) by Lord Gough (bay) out of Danseuse (brown) is described as a bay. Here again he does not state the whole truth. As a matter of fact, this filly was returned as bay when a foal, but her breeder specially altered the colour to *light dun* in vol. xix. She had then reached maturity, and was a brood mare.

I do not wish to take up your space in quibbling as

to whether *bay-dun* or *bay or dun* better describes the filly (1907) by Ash (chestnut) out of Unexpected (bay). Here, however, is another instance of reversion to dun which has come under my personal notice, viz. bay-dun hackney filly (foaled 1898), bred by the late Dr. W. Wingate Saul. She was by General Gordon, brown (gametic composition brown-chestnut); her dam, Fanny Gordon, a light yellow bay with black dorsal band. Fanny Gordon was by General Gordon out of Lancaster Fanny, dark liver-chestnut. J. B. ROBERTSON.

Lancaster.

Lower Cretaceous Angiosperms.

IN the course of my work at the British Museum on Cretaceous plants, I have examined a number of more or less perfectly petrified "woods." Such specimens have generally been classed together as "Gymnosperms," so that they have received little attention from palæobotanists. As I am undertaking an exhaustive study of the Cretaceous plants, the keeper of geology has had sections made of all the likely specimens of woods.

Among those sectioned are Nos. V. 11517, V. 5654, and V. 5452. These are of exceptional interest, because they prove to be, not Gymnosperms, but Angiosperms. One of them is further notable in having its phlœm and cortex petrified, as well as the wood; the majority of silicified woods having lost these soft tissues. The specimens were collected at different times, which minimises the chances of error in referring them to the Lower Greensand; and from geological and petrological evidence there is no reason to doubt that they are, as labelled, of Lower Greensand age (*i.e.* the Aptian of the Continent).

I hope shortly to publish a complete and illustrated account of these specimens, but I make the discovery public now in the hope of obtaining further evidence. Hitherto the floras between the Wealden and Tertiary ages in Britain have not received much attention, owing to the very scanty and imperfect nature of the fossils representing them. Nevertheless, many collectors may have laid aside "wood" from the Greensands, Gault, or Chalk, and, if so, might be willing to lend them to me for examination.

So far as I am aware, the specimens, the nature of which I have recently determined, are not only the oldest Angiosperms from the north of Europe, but are the oldest from any locality with *petrified* structure. From the succeeding Albian, Fliche described an angiospermic wood —*Laurinoxylon albiense*—which he remarked was then (1905) the earliest known petrified Angiosperm. The numerous Angiosperms described from the United States and elsewhere from the Potomac and succeeding formations are leaf impressions only.

The existence of Angiosperms in northern Europe at so early a horizon as the Aptian is a fact which will necessitate revision in some current views as to the early distribution of the most important group of plants.

Manchester University. M. C. STOPES.

The Cocos-Keeling Atoll.

As a contribution from a frank supporter of Sir John Murray's theory of the formation of the lagoons of atolls by solution, I welcome the criticism of Miss Drummond (NATURE, November 24).

I must, however, point out that the discussion does not concern the question of the power of sea water to dissolve calcium carbonate, a fact which, so far as I know, is not doubted, but deals with the more special problem of whether this power for solution is the factor which has caused the development of atoll lagoons.

She has asked me a question, and I think that she has herself given the answer to it.

Taking the case which Miss Drummond presents, and accepting all her figures, we have the following facts. Normal sea water contains 0·12 gram of calcium carbonate per litre, and will form no precipitate on standing for any length of time. Sea water that contains more than this quantity (*i.e.* 0·649 gram per litre) will deposit calcium carbonate "in the crystalline form, and the deposition may go on until the solution contains less than is normally present in sea water." . .

In this last case, the saturation of the solution, in falling from 0·649 gram per litre to less than that of normal sea water, has passed through a stage at which it is represented by the normal 0·12. Therefore, in this case, sea water containing 0·12 gram of calcium carbonate per litre will precipitate calcium carbonate, and go on precipitating it until it contains "less than is normally present in sea water." This fact therefore negatives the first statement that sea water containing 0·12 gram per litre will not precipitate. What is the factor that determines the precipitation from normal (0·12) saturation in this case when, as Miss Drummond says, sea water when allowed to stand will not precipitate? I would suggest that it is the presence in the solution of the already formed crystals of calcium carbonate—a condition which is also present "in the interstices of the massive corals in the lagoons."

F. WOOD-JONES.

Conflicting Dates of International Congresses.

AT the request of the Swedish geologists, the International Geological Congress took place this year instead of in 1909. This year was also that in which the International Zoological Congress naturally fell to be held. Since, for the convenience of university workers, these congresses are usually held at the same time of year, and since they, with their excursions, now extend over a considerable period, especially in the case of the Geological Congress, it was almost inevitable that the times of the meetings should clash. This may not affect a large number of participants, but it is rather hard on palæontologists, whose interests lie in both camps, and who, even with the aid of the aëroplane, cannot be in two places at once.

I should not trouble you with a complaint about what appeared to be inevitable this year were there not signs of the same difficulty recurring in perpetuity unless protest is at once raised. As a matter of fact, the committee of "Palæontologia Universalis," when it met at Stockholm, forwarded to the council of the congress a request that this interference should be avoided in future. That protest seems to have been without result. If so, in 1913 the palæontologist will again find himself summoned either by duty or desire to opposite quarters of the globe.

F. A. BATHER.

The Megalospheric Form of *Ammodiscus incertus*.

THE interesting discovery of the megalospheric form of the above species in some abundance in the North Pacific Ocean, as described by Mr. J. A. Cushman in Bulletin No. 71, U.S. National Museum, 1910, pp. 73–5, and noticed in NATURE of September 1, brings to mind the remarkable occurrence of the megalospheric form only (*A. tenuis*, Brady) in some dredgings off Great Barrier Island, New Zealand, which I described in the Transactions of the New Zealand Institute in 1905 (1906). Curiously, the microspheric form was there entirely absent, although Dr. H. B. Brady had previously recorded it from a neighbouring *Challenger* station, No. 169. The latter author regarded *A. tenuis* as perhaps a local variety of the better known *A. incertus*. Rhumbler suggested that the form was possibly the megalospheric stage of the species, whilst the present writer, noting a large amount of variation in the initial chamber, suggested that a microsphere might be present in forms otherwise to be regarded as *A. tenuis*, giving the diameter of the initial chamber in the New Zealand specimens as 100 μ to 50 μ. Mr. Cushman's published figure shows an approximate internal diameter of the proloculum as 250 μ, which is nearer to Brady's published figures than to the examples from the Great Barrier Island. I am now convinced that the specimens from the latter locality had abnormally small megalospheres, giving the minima of measurements so far as known.

A question here arises how to account for the remarkable abundance of *Ammodiscus incertus*, clearly of microspheric relationship, in fossiliferous strata from the Upper Silurian to the late Tertiary. With that problem as a suggestion for observant rhizopodists I conclude this note.

F. CHAPMAN.

National Museum, Melbourne, October 20.

THE PHOTOGRAPHY OF NEBULÆ.

SINCE the year 1880, when Henry Draper, of New York, achieved the first success in photographing nebulæ, namely, the great nebula in the constellation of Orion, the progress made in this branch of astronomy has been both rapid and secure. In this country Common and Isaac Roberts, in France Janssen and the brothers Henry, in Germany Max Wolf, and in the United States W. H. Pickering, Barnard, and Keeler, all have helped to obtain the high standard of excellence which prevails to-day.

Both refracting and reflecting telescopes have been rivalling each other to obtain the mastery in this particular branch, and I think that it is generally conceded to-day that the latter have won the day. The great success achieved is no doubt partly due to the important progress made in the preparation of the photographic dry plate, but a closer scrutiny of the whole situation brings into the light the peculiar skill of the man at the telescope. Isaac Roberts, for instance, had not a very large reflector to work with, one of only 20 inches aperture, yet his skill in tuning up his instrument and his very careful "following" were rewarded by the magnificent set of wonderful photographs which he was able to secure.

Again, Keeler, with the Crossley three-foot reflector, an instrument made in 1879 by Dr. Common, which only reached the United States in 1895, achieved his success only by making a very careful study of and alterations in the telescope and its accessories. While the changes he made were small, they had, as he said, "greatly increased the practical efficiency of the instrument, and therefore, small as they are, they are important." Unfortunately, Keeler died soon after he had commenced his photographic study of the nebulæ, but the handsome volume published as a tribute to his memory ("Publications of the Lick Observatory, vol. iii., 1908"), and containing splendid reproductions from his negatives, will give the reader some impression of the fineness of his work.

Beautiful as the photographs which up to the present time have been secured are, there was inherent in them some defects which it might have seemed impossible to eliminate. There is little doubt but that all these photographs must now be consigned to the second position, to be replaced by those that are the work of Prof. G. W. Ritchey, of the Mount Wilson Observatory.

Prof. Ritchey is one of the band of valuable men which Prof. George E. Hale was fortunate enough to surround himself with in the establishment of the Mount Wilson Solar Observatory. Prof. Ritchey was previously one of the staff of the Yerkes Observatory, and was in charge of the instrument shop at that observatory, and this shop was regarded of very great importance, since it alone rendered possible the construction and frequent improvement of instruments of new type or special design; provision was also made for optical work on a large scale. At the Mount Wilson Observatory the instrument shop was naturally of fundamental importance, and it was not long before the figuring and mounting of a 5-foot reflector was undertaken. This instrument was first tested visually in December of the year 1908, and the first celestial photograph was secured in the same month of that year. The instrument, mounting, dome, building, and accessories were all carried out from the plans of Prof. Ritchey, and it is with this powerful instrument of research and close attention to refinements that he has been able to make this progress in the photography of nebulæ.

In the efficient working of a reflecting telescope it is of great importance to secure as far as possible equal temperature conditions for the telescope, dome, and inside and outside air. Thus the telescope and mirror must not be allowed to be heated up during the daytime because change of temperature causes a deformation of the reflecting surface of the mirror and an alteration in the length of the telescope itself. Again, bright sunshine on the dome causes the building to become heated, and this in turn affects the telescope and mirror and produces temperature errors.

It is chiefly the elimination or practically the almost complete elimination of such temperature changes that has allowed Prof. Ritchey to secure his admirable photographs, and a brief account of the way he has achieved success will be of interest. In the first place, tests were carried on in the optical shop to determine how large a *daily* variation of temperature was permissible without seriously affecting the figure of so large and thick (19·4 cm. at edge, 17·5 cm. at centre) a mirror. By allowing the air temperature about the mirror to rise and fall uniformly for twelve hours

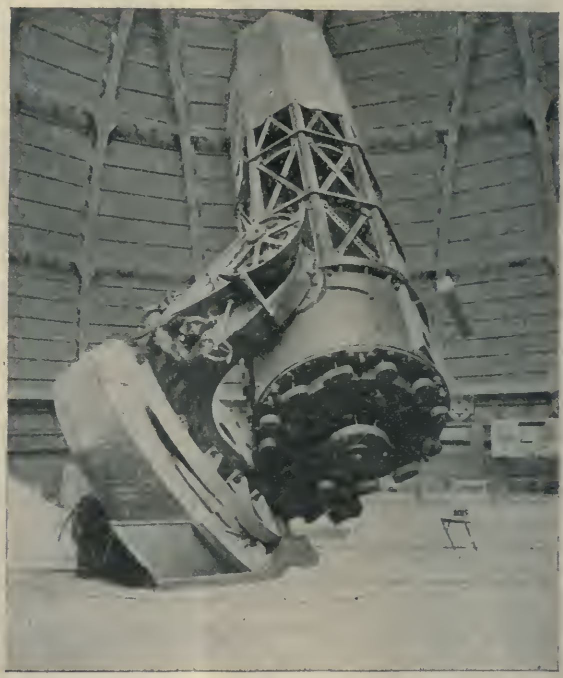

FIG. 1.—The 60-inch reflector mounting in dome.

respectively through 0° F. to 10° F., the most marked effect on the mirror was a decided disturbance of the figure on the outer zones of the surface for a distance of 3·5 or 4 inches in from the edge, these zones becoming too high as the temperature rose, and receding and even becoming too low when the temperature fell. The remaining zones were only slightly affected and the change of focal length of the mirror was small. It was finally decided that a daily variation of the large mirror of 2° F. was the maximum variation that could be permitted without perceptible injury to the sharpness of photographic star-images. When it is mentioned that the daily variation of the temperature in the unprotected dome in clear weather in the latter half of June, 1909, at Mount Wilson averaged 20° F., it will be gathered that the mirror must have altered its figure very considerably. The contraction of the steel skeleton tube was also very noticeable, for the apparent change of focal length found during the night frequently amounted to 0·04 inch.

To maintain a nearly constant temperature, Prof. Ritchey now encloses the greater part of the telescope during the daytime in a light, removable room or chamber, with insulating walls, which he calls the "canopy." The walls of this consist of four thicknesses of fine woollen blankets quilted between covers of white canvas, while the floor is of mats two inches thick, made of cheap woven hair, sewed between covers of heavy canvas. At the upper south portion of the canopy the head end of the skeleton tube projects, and this opening is closed airtight by a folding wooden cover lined with wool felt. In addition to these precautions the large mirror is protected by a short cast-iron tube, and by the airtight covers which protect its surface. Arrangements are made for moving the canopy easily and entirely out of the way of the telescope when in use, and replacing it when observing is completed. While the telescope was protected in the above manner, a sun shield was used to reduce the daily variation of the dome. This consists of gores of heavy white canvas laced to a strong framework of steel pipe. The canvas was thus retained two feet from the steel covering of the dome, due provision being made for the free circulation of the air beneath the canvas. In this way the daily variation in the dome was decreased to 10° F. in July, while the change in focus of the mirror was reduced to 0·02 inch.

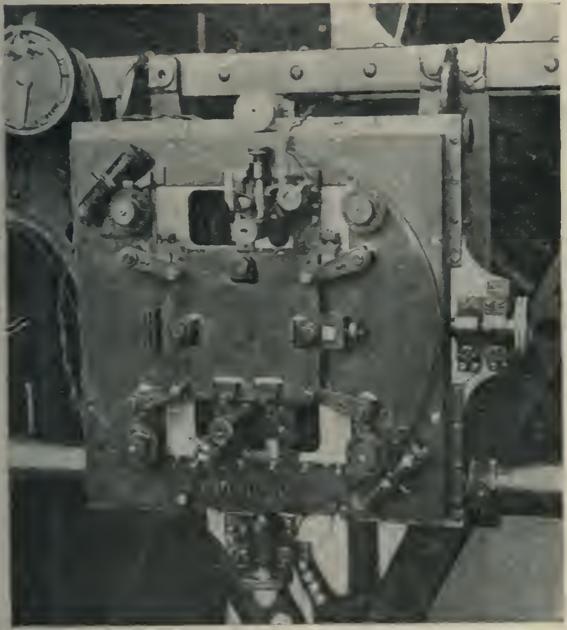

FIG. 2.—The new photographic plate carrier on the 60-inch reflector.

By the combination of shield and canopy, the inside daily variation of temperature in the latter was only 3·8° F. in August and September, and the apparent alteration of focus reduced to 0·005 inch. Prof. Ritchey proposes, in future, two improvements when he still further hopes to reduce this daily amplitude of variation, first to place in the canopy a small refrigerating apparatus with a controlling thermostat, and, second, to enclose the complete telescope in the canopy.

With these refinements in controlling temperature changes, he adopts the knife-edge method of focussing the stellar images, a most important consideration in stellar or nebular photography. By this means he is able to locate the focal plane to within 0·001 inch. With the help of his new plate-carrier, the focal plane and the plane of the film of the photographic plate can with certainty be made to agree within 0·0003 inch. While making an exposure he has occasionally to remove the plate to check the position of the focal plane of the mirror. Since the adoption of the canopy and shield he has found that re-focussing about every half-hour in the early part of the night, and about every three-quarters of an hour after 11 p.m., is sufficient for accurate working.

The efficiency of the whole instrument is such that Prof. Ritchey states:—

"All of the uncertainties which usually occur in making long exposures with very large instruments are eliminated. A plate can be exposed night after night, if desired, with the assurance that no error in focus greater than one or two-thousandths of an inch can occur, and that no rotation of field can take place without immediately being detected and corrected. Both of these conditions are absolutely necessary for the finest results with an instrument so powerful and sensitive as the 60-inch. . . . On the best of these negatives, with exposures of eleven hours, the smallest star-images are 1·03 seconds in diameter."

To ensure the finest of final products, Prof. Ritchey lastly abandons the use of rapid plates, which, as is well known, are always associated with coarseness of grain, and employs Seed "23" plates almost exclusively.

A close examination of the reproductions of some of the nebulæ which he publishes with his latest communication indicates in a striking manner the wonderful sharpness and richness in detail of his photographs. It is interesting in this respect to compare Ritchey's photograph of the spiral nebula Messier 51 Canum Venaticorum, with that of Keeler, reproduced in vol. viii. of the "Publications of the Lick Observatory" (plate 47), those of Isaac Roberts in vols. i. and ii. of his "Photographs of Stars, Star Clusters, and Nebulæ" (plates 30 and 15 respectively), and, lastly, that by Ritchey himself, taken with the 2-foot reflector of the Yerkes Observatory, and published in vol. ii. of the "Publication of the Yerkes Observatory" (plate 29).

Bearing in mind the differences in quality of the reproductions to which references above are given, the superiority of Ritchey's latest achievement is well marked.

In a more recent announcement (*Monthly Notices*, R.A.S., vol. lxx., Supplementary Number, No. 9), and dated September 17, Prof. Ritchey directs attention to very important conclusions which he is able to arrive at from his recent photographs. These are that the spiral nebulæ are not only distinguished by many sharply-marked characteristics from all other classes of nebulæ, but that the spirals themselves exhibit marked differences from each other in regard to the distribution of the nebulous stars, differences which, as he states, possibly correspond to successive stages of development.

It is in the presence of such photographs as these, and more especially those where the nebulæ are of a spiral nature, that one's attention is directed to the question of the origin of stars themselves.

"All self-luminous bodies," as Sir Norman Lockyer states in the first of his General Conclusions at the end of his work 'The Meteoritic Hypothesis,' "in the celestial spaces are composed either of swarms of meteorites or of masses of meteoritic vapour produced by heat. The heat is brought about by the condensation of meteor swarms due to gravity, the vapour being finally condensed into a solid globe."

Such a photograph as that of Messier 51 seems to represent the above words in picture form. Prof. Ritchey, in commenting on these spirals, which he has most recently photographed, says, that they all "contain great numbers of soft star-like condensations which I shall call *nebulous stars*. They are possibly stars

in process of formation. In general they lie in streams which follow the curvature of the convolutions. Together with the smooth nebulous material in which they are apparently floating, and out of which they are apparently forming, they constitute the convolutions."

While a detailed study of individual nebulæ endorses the meteoritic hypothesis regarding the formation of stars, the hypothesis itself requires the presence of a considerable quantity of self-luminous or non-luminous matter scattered throughout space. The recent advances in the photography of nebulæ have, however, very considerably altered the generally conceived notions regarding the amount of nebulous matter distributed in the heavens. After Keeler turned his attention towards photographing nebulæ, he soon found that he was able considerably to increase the number of known nebulæ with the aid of the Crossley reflector. In this research he reached two important conclusions:—

(1) "Many thousands of unrecorded nebulæ exist in the sky. A conservative estimate places the number within reach of the Crossley reflector at about 120,000. The number of nebulæ in our catalogues is but a small fraction of this." (2) "Most of these nebulæ have a spiral structure."

In the preface to the volume containing Keeler's photographs it is stated:—

"The number already discovered and catalogued did not exceed 13,000. Later observations with the Crossley reflector, with longer exposure-times and more sensitive plates, render it probable that the number of nebulæ discoverable with this powerful instrument is of the order of half a million."

While the above estimate relates to the capacity of the Crossley reflector, what number of additional nebulæ should be added when the very much greater efficiency and aperture of the Mount Wilson Observatory's reflector is taken into account? Prof. Ritchey, as has been shown above, has demonstrated the far-reaching capacity of this instrument and its enormously improved efficiency for nebular photography. Further, when the 100-inch reflector of the same observatory is brought into use, what will then be the approximate number of known nebulæ?

Again, while all these instruments can only record the existence of self-luminous matter in space, what estimate should be made for the number of regions in the sky in which matter which is not luminous is present? The only conclusion that can at present be drawn is that amount of matter distributed in space is really enormous compared to that which is generally conceded to be the case. If, as very probably is the case, this non-luminous matter is as frequently distributed as that which is luminous, then any hypothesis to explain inorganic evolution must be founded on a meteoritic basis.

The work of modern large reflecting telescopes in adding to our knowledge of the probable amount of nebulous matter in space is of very great importance, and the magnificent success of Prof. Ritchey in his latest achievement forms another opportunity for the hearty congratulations of all astronomers to be extended to him. Prof. Ritchey is to be envied, not only for working in a country where astronomy in all its branches is so well fostered, but for being one of the members of the staff of the Solar Observatory on Mount Wilson, an observatory which is so magnificently endowed. On that mountain, when it is decided that a spectroheliograph, which we in this country would consider of very large dimensions, would be capable of accomplishing better research if another of double its size were instituted, then promptly the necessary funds are forthcoming, and the instrument is taken in hand, built, and brought into use. Again, no sooner is a 60-inch mirror found to be a very great advance in celestial photography than one of 100 inches in diameter is immediately projected, and all necessary arrangements for its completion and erection are made. With such facilities for research, so incentive to those who are employed in the investigations, no wonder that work of the highest quality and importance can be turned out; for this reason this country, like many others, is being left far behind.

FIG. 3.—Spiral Nebula Messier 51 Canum Venaticorum. Photographed with the 60-inch reflector and the new plate carrier. Exposure 3h. 55m., February 7 and 8, 1910. Notice the roundness of the star images.

WILLIAM J. S. LOCKYER.

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held as usual on St. Andrew's Day, November 30, when the report of the council was presented, and the president, Sir Archibald Geikie, K.C.B., delivered an address. Most of the matters mentioned in the council's report have been referred to already in the columns of NATURE, and others are of domestic, rather than of general scientific, interest. The council has decided "that the surplus annual income of the Darwin Fund, after providing for the silver medal and money gift prescribed by existing regulations, be devoted, not to the provision of scholarships or medals, but to the furtherance of biological research in the Darwinian field."

Upon the recommendation of the president and council of the society, the Government has agreed to continue its subscription to the International Association of Seismology for six years more, up to the end of March, 1916. In alluding to this decision in his address, the president took the opportunity to refer to Dr. John Milne's extensive work in modern observational seismology. "The valuable service which he has thus rendered to the study of earthquakes has been universally recognised, and there is a widespread conviction that the system of observing stations which he has created is worthy of being made a national undertaking."

It is proposed to publish a collected edition of the works of Sir William Herschel, under the editorial supervision of Dr. J. L. E. Dreyer. The cost will be shared with the Royal Astronomical Society.

A number of facts of importance relating to sleeping sickness in Uganda have been described by Sir David Bruce and his colleagues in papers presented to the society. The council reports as follows:—

Research on Tropical Diseases.

The work of the commission in Uganda has confirmed the conclusions, mentioned in the council's report of last year, that the *Glossina palpalis* is capable of conveying the infection of sleeping sickness for a much longer period than was thought to be the case at first, and that this fly may act as a carrier of other trypanosome diseases, such as those animal diseases that are produced by *Trypanosoma dimorphon*, *T. vivax*, and *T. nanum*.

One of the most important results of the last year's work of the commission is the discovery that the flies of the lake shore are still capable of transmitting the infection of sleeping sickness, although two years have now elapsed since the population was removed. The cause of this has not yet been ascertained with certainty, but further work is being done to determine, if possible, whether there is an animal reservoir for the *T. gambiense*, and especially whether cattle and antelope harbour the parasite of the disease, as laboratory experiments made at Mpumu suggest. This is a question of great importance with regard to the means to be adopted to control the malady.

The commission has not only done a great deal of work on sleeping sickness, but a number of researches on other maladies, human and animal, have also been carried out. Thus a disease affecting the natives in the province of Ankole, and known as "muhinyo," was investigated by Sir David Bruce and his colleagues, and the very interesting discovery was made that this malady was really Malta fever, and affected both men and goats in Central Africa.

In his presidential address, Sir Archibald Geikie referred to the losses by death sustained by the society during the year. These include the patron, King Edward VII.; foreign members: Alexander Agassiz, Stanislao Cannizzaro, Giovanni Schiaparelli, Robert Koch, Friedrich Wilhelm Kohlrausch, and Melchior Treub; and fellows, Sir William Huggins, Dr. Ludwig Mond, Dr. Shelford Bidwell, Sir Robert Giffen, Rev. Robert Harley, Mr. J. B. N. Hennessey, Mr. Edward Saunders, Sir Charles Todd, and Mr. C. Greville Williams.

The work of the medallists for this year was described by the president in the following words:—

COPLEY MEDAL.

The award of the Copley medal has this year been made to one of our own countrymen, who has been more than fifty years a Fellow of the Royal Society. Sir Francis Galton's life has been one of ceaseless activity in many varied departments of intellectual effort. Few of us can remember how he began as an enthusiastic explorer and geographer, "urged," as he confessed, "by an excessive fondness for a wild life," and with "the love of adventure" as his chief motive. He chose south-western Africa as the theatre of his exploration, penetrated into regions where no European foot had preceded him, and brought back with him a vivid impression of the scenery, physical geography, natural history, and ethnology of Damaraland and South Ovampoland. He embodied his observations in an interesting volume of travel published in 1853. That work showed that he was no mere hunter after game or seeker of adventure, but a shrewd and observant traveller, with his eyes open to every distinctive natural feature in the countries and their inhabitants. His experience in these African journeys led him to plan and to publish in 1854 his well-known and admirable handbook, "The Art of Travel," which, as a pioneering treatise in the practical methods of scientific exploration, has proved of inestimable service to the travellers of the last half-century.

Sir Francis at an early period of his career was led to interest himself in meteorology, which, as a science of observation, was then in its earliest infancy. With much labour and skill he constructed weather charts, and discussed meteorological statistics. His zeal and success in these studies led to his being chosen a member of the Meteorological Council at its origin, and he remained in that position until the council was superseded in 1901 by the Meteorological Office. He likewise acted as chairman of the Royal Society's Committee of Management of Kew Observatory from 1888 until 1900, when the work of this committee became merged in that of the National Physical Laboratory.

But it was not only in geography and meteorology that Sir Francis Galton manifested his versatile energies. He was much interested likewise in biological studies, especially in regard to questions of relationship and heredity. So far back as 1871 he began what has proved to be a voluminous and important series of contributions to these subjects. From his first paper, "Experiments in Pangenesis," down to his last volume on "Eugenics," his successive papers have shown a continuous development of ideas and conclusions. He was led from his early ethnological inquiries into the mental peculiarities of different races to discuss the problems of heredity genius from the fundamental postulate that "a man's natural abilities are derived by inheritance under exactly the same limitations as are the form and physical features of the whole organic world." To obtain further data for the discussion of this subject he carried out the elaborate statistical inquiries embodied in his "English Men of Science." Confident in the results of these researches, he proceeded after the manner of "the surveyor of a new country who endeavours to fix, in the first instance, as truly as he can, the position of several cardinal points." His results in this quest were given in his "Inquiries into Human Faculty and its Development," published in 1883. A further contribution was made by him in 1889, when his work on "Natural Inheritance" appeared. His subsequent papers and essays on "Eugenics" have still further stimulated inquiry into a subject of such deep interest and transcendant importance in all efforts to improve the physical and mental condition of the human race. It has seemed to the council fitting that a man who has devoted his life with unwearied enthusiasm to

the study and improvement of many departments of natural knowledge, whose career has been distinguished by the singleness and breadth of its aims and by the generosity with which he has sought to further them, should receive from the Royal Society its highest award in the Copley medal.

RUMFORD MEDAL.

The Rumford medal has been awarded to Prof. Heinrich Rubens, in recognition of the value of his researches in radiation. For many years he has been engaged in the experimental investigation of optical radiations of very long wave-length. In the course of this work he elaborated, in conjunction with Prof. E. F. Nichols, a method of isolating pencils of nearly homogeneous rays, using the fact that a non-metallic substance reflects very copiously waves of the same length as those to which it is opaque. If, then, a pencil of rays of mixed wave-lengths is reflected several times to and fro between mirrors of the same kind of substance, the rays finally emerging (the "Reststrahlen") have the wave-lengths of the kinds of light which the substance refuses to transmit. The light of other wave-lengths has been transmitted freely at each incidence, and by a sufficient number of reflections is ultimately removed from the pencil. By using different substances as reflectors, Prof. Rubens has isolated infra-red light of various wave-lengths up to as much as 96 μ, or about 0·1 of a millimetre; while, on the other hand, purely electric waves have been produced of wave-lengths as small as 2 millimetres. He has thus enormously extended our knowledge of the infra-red spectrum. Moreover, in conjunction with colleagues, he has investigated the absorbing and reflecting powers of substances for these long wave-length rays. He has shown that, for radiation of wave-length even fewer than ten times the wave-lengths in the visible spectrum, the reflecting and absorbing powers of metals and alloys are determined by their electric conductivities alone, in accordance with Maxwell's theory. It followed from Maxwell's own observations on the absorption of gold-leaf for visible light that agencies more complex than conductivity must be involved for these shorter wave-lengths.

Prof. Rubens has recently applied to the measurement of the long infra-red wave-lengths a quartz interferometer, and among other results he has found that the refractive index of water, for waves of length about 82 μ, is of the same order as for waves in the visible spectrum, while for the shortest Hertzian waves yet examined, about 2000 μ, it is as high as 9.

These examples will serve to illustrate how much Prof. Rubens has already done to bridge the gap between optical radiations and electric waves produced by direct electric agency, and how much more is to be expected from him in the investigation of the interval still remaining in which such fundamental changes of properties take place.

ROYAL MEDALS.

The awards of the two Royal medals given annually by our Patron the King have received his Majesty's approval.

One of these medals has been assigned to Prof. Frederick Orpen Bower, in recognition of the great merit of his contributions to morphological botany, of which department of science he is the acknowledged leader in Great Britain. Prof. Bower's early studies in this field (1880–2), on the genera Welwitschia and Gnetum, were marked by the discovery of the true nature of the two persistent leaves in Welwitschia. The next period of his work was given to a study of the morphology of the leaf. He developed in 1884 the idea of the phyllopodium or leaf-axis, and discussed in 1885 the apex of the leaf in Osmunda and Todea. This latter study was cognate to subsequent researches, the results of which were given in 1886 in a review of "Apospory and Allied Phenomena." This work, of much intrinsic interest, is important as having led its author to formulate the views advanced in 1890 in a memoir on "Antithetic as distinguished from Homologous Alternation [of Generation] in Plants." Another memoir, published in 1889, on "The Comparative Examination of the Meristems of Ferns as a Phylogenetic Study," prepared in the light of the then received belief that the leptosporangiate ferns are the more primitive, was followed in 1891 by a discussion of this question, in which Prof. Bower advanced morphological reasons for reversing the hitherto accepted phylogenetic order. The new conclusion has proved to be in accord with palæobotanical results, and marked another distinct step in the advancement of botanical science. During the third period of his work, 1892–1903, Prof. Bower's papers, including an important series on the spore-producing members, have resourcefully maintained the antithetic doctrine, and have afforded a striking instance of the advantage of a well-considered working hypothesis as a guide to investigation. The career of morphological research here outlined has been recently crowned by the publication (1908) of a book on "The Origin of a Land Flora," which is one of the "most important contributions to the advancement of natural knowledge, published originally in his Majesty's dominions," within the period prescribed in respect of the award of Royal medals.

The other Royal medal has been adjudged to Prof. John Joly, who is eminent in two branches of science, geology and physics. This combination of studies has proved to be reciprocally fruitful to both departments. It was from his mineralogical interests that he was led to devise the steam calorimeter, which has enriched physics with an apparatus of high refinement. The use of this method was extended by him to the direct determination of the specific heats of gases at constant volume, a measurement dealing with minute quantities of heat in circumstances quite beyond the capabilities of the usual forms of calorimeter. Among many contributions to standard physical data, which are accepted and in use, may be instanced his determination of the density of saturation of steam. His meldometer, primarily intended for determining the melting points of mineralogical and geological specimens, has been the means of providing data for use in thermometry. He has devised and applied a method of determining the change of volume of rocks and other substances on fusion, which is a datum of primary importance for cosmical theories. He has carried out a refined research, with negative results, on the possibility of minute change of mass (as distinguished from weight) accompanying chemical combination. His recent extended investigations of the occurrence of radio-active substances in materials from various strata have been utilised for fundamental geological discussions. Of other useful inventions which he has introduced, one of the best known is the translucent block photometer.

Prof. Joly has made important contributions to the subject of colour photography, and devised some years ago a three-colour system in which all three colours are present on the same plate in the form of fine parallel lines or small dots.

He has also contributed substantially to the theory of biological processes, such as the ascent of sap in vegetation. Reference may likewise be made to his suggestive memoir on the age of the earth, based upon a discussion of the chemical constitution of the ocean.

DAVY MEDAL.

The Davy medal has been assigned this year to Prof. Theodore W. Richards, as a mark of appreciation of the value of his work in the determination of the atomic weights of the elements. His researches on this subject have not been surpassed in comprehensiveness by those of any other chemist. He has himself determined the atomic weights of no fewer than fourteen elements, and many other atomic weight determinations have been made under his direction and superintendence. The accuracy of the numbers obtained is certainly much higher than that which has been attained by any previous series of researches, and it is impossible to speak in too high terms of the ingenuity, the unremitting labour, and the masterly manipulation which Prof. Richards has brought to bear on his investigations.

In addition to this work on atomic weights, Prof. Richards has made many important contributions to physical chemistry, and it is probably no exaggeration to say that he has done more to raise the standard of accuracy in physico-chemical work than any other living

chemist. Theoretical contributions to this branch of science are comprised in a series of papers on "The Possible Significance of Changing Atomic Volume," in which he suggests a relation between the energy of the atoms and their compressibilities. In order to test his hypothesis, he has made a long series of investigations on the compressibility of elements and compounds. He has determined this constant for nearly all the solid and liquid elements, and he has shown that the compressibility is a periodic function of the atomic weights. In electrochemistry Prof. Richards has made important determinations of the electro-chemical equivalent of silver, and he has supplied some of the most rigorous proofs of the universality of Faraday's law.

Darwin Medal.

To Mr. Roland Trimen, who was for many years curator of the South African Museum in Cape Town, the Darwin medal has been awarded. His official position, and the duties it involved, enabled him to do admirable work in African zoology. His name will always stand with those of Bates and Wallace in the establishment and illustration of the theory of mimicry. In addition to his researches on that subject, he has done admirable systematic work, his descriptions of insects, especially the *Lepidoptera rhopalocera*, being models of accuracy and literary style. He, furthermore, rendered the greatest assistance to Charles Darwin, especially in his work on orchids—assistance the high value of which is acknowledged in a long series of that great naturalist's published letters.

Sylvester Medal.

The medal which perpetuates the name and mathematical prowess of James Joseph Sylvester has this year been assigned to Dr. Henry Frederick Baker, in recognition of his work in the theory of functions, wherein he has shown himself to be a profound analyst. His book on the Abelian functions, published in 1897, is a classic, and probably no better guide to the analytical development of pure mathematics has appeared during the last three-quarters of a century. While basing the argument of the work on the methods of Riemann, he never loses sight of the arithmetical ideas which we owe to Kronecker, Dedekind, and Weber, or of the geometrical notions brought to light by the labours of Clebsch, Gordan, Noether, and Klein. The critical insight which was thus in evidence marked him out a few years ago as the editor of "Sylvester's Collected Papers." This work, which, with the approaching issue of the fourth and last volume, may be said to be complete, has been necessarily a difficult task, which, besides making demands upon the resources of an accomplished mathematician, has entailed no little editorial labour. Dr. Baker, by explanatory and critical observations, and by frequent ameliorations of the text, has done much to assist mathematical students. His scholarly work has resulted in a faithful record of the course of Sylvester's thought. It seems eminently fitting that the Sylvester medal should be given to one who has erected so lasting a memorial to the great mathematician.

Hughes Medal.

To Prof. John Ambrose Fleming the Hughes medal has been awarded. For thirty years he has been actively engaged in researches in experimental physics, chiefly in the technical applications of electricity. He was an early investigator of the properties of the glow lamp, and elucidated the unilateral conductivity presented in its partial vacuum between glowing carbon and adjacent metal, a phenomenon which has been linked up recently with the important subject of the specific discharges of electrons by different materials. He has published in the scientific and technical Press, and in technical text-books, many admirable experimental investigations and valuable expositions in the applications of electricity, as, for example, to electric transformers and wireless telegraphy. Of special interest and value for theory were the important results concerning the alterations in the physical properties of matter, such as the remarkable increase in the electric conductivity of metals when subjected to very low temperatures, which flowed from his early collaboration with Sir James Dewar in investigating this domain. In recent years he has taken a prominent part in the scientific development of telegraphy by free electric waves.

In the evening the fellows and their guests dined together at the Whitehall Rooms, Hotel Metropole.

ENTERIC FEVER CARRIERS.[1]

THE frequent difficulty in accounting for the source of infection of enteric fever once led to the theory that this disease could arise *de novo*, that is to say, that certain organisms in human dejecta were capable of developing, in favourable circumstances, into enteric fever organisms. It has also been maintained more recently that the specific organism of this disease was capable of living and multiplying in water and soil, for considerable periods. But the bacteriological work of the past few years has discredited both these hypotheses; and the "carrier" case of enteric fever or the mild, unrecognised case of infection generally, explain the transmission of the disease in those cases in which the disease crops up in the absence of any recognised sufferer from the disease.

A "carrier" of enteric fever is a person who, although he may be in good health, carries the infectious material in his body, from which it may pass out. He is not merely a passive transmitter of infection; he is also a breeding-ground and storehouse of these specific organisms; and it appears that not only those sick with the fever, but also healthy persons who happen to be "carriers" of the infection, offer the best explanation for the maintenance of the infection in communities.

The subject has naturally attracted much attention and led to many investigations, the results of which are to be found in numerous recent publications, and Dr. Ledingham has done a great service in preparing for publication a summary of the more important investigations that have hitherto been made of this subject. He gives the history of a large number of occurrences of enteric fever in domestic life, in institutions, and in military populations, in which the source of infection has been traced more or less convincingly to a "carrier." In many of these cases the evidence is conclusive that the infection was conveyed by food or milk. The recorded instances go to prove that the female sex is more liable to carry the infection than the male, and that of both sexes some 2 to 4 per cent. of previous sufferers may continue to harbour the germ, and become "carriers," who intermittently discharge the germ, for periods extending maybe for many years.

As Dr. Theodore Thomson, who writes an introduction to this report, states, the difficulty of dealing with "carriers" is very great indeed, having regard more particularly to the long periods during which people may harbour the infection and to the fact that it has hitherto proved very difficult to free them from the infection. The chief available measures include: all possible efforts to detect "carriers" in the community, and to endeavour to secure on the part of a "carrier" those precautions of strict personal cleanliness and of disposal of dejecta that will minimise the risk of infecting others; an endeavour must also be made to prevent such "carriers" from taking any part in the milk trade or in the preparation or handling of food.

In this interesting report, Dr. Ledingham also discusses the diagnostic methods employed in the search for "carriers" and the immunity question in "carriers." A useful bibliography is appended.

[1] Dr. J. C. G. Ledingham's Report to the Local Government Board on the Enteric Fever "Carrier"; being a Review of current knowledge on this subject. Pp. 138. (London: Wyman and Sons, 1910.) Price 1s.

NOTES.

LORD AVEBURY has been elected a corresponding member for the section of anatomy and zoology of the Paris Academy of Sciences.

WE regret to see the announcement of the death, on November 24, at sixty-four years of age, of Prof. Angelo Mosso, professor of physiology in the University of Turin.

WE learn from the *Revue scientifique* that the new astronomical observatory in the gardens of the Vatican was opened on November 17.

THE *Terra Nova*, with the members of Captain Scott's Antarctic expedition on board, left Port Chalmers on November 29 on her way south.

PROF. R. A. SAMPSON, F.R.S., professor of mathematics and astronomy in the University of Durham, has been appointed Astronomer Royal for Scotland and professor of practical astronomy in the University of Edinburgh, in succession to Mr. F. W. Dyson, F.R.S.

ON account of the General Election, the annual dinner of the Institution of Electrical Engineers (originally fixed for December 6) has been postponed to Thursday, February 2, 1911.

THE French Society of Biology has, says the *Revue scientifique*, awarded the Godard prize to Mlle. Anna Drzewina. The prize is awarded every other year for the best biological work.

THE Emperor Francis Joseph has conferred the Austrian great gold medal of science and literature upon Mr. E. Torday, the leader of the scientific expedition sent out by the British Museum to study the native tribes in the Kasai basin of the Congo.

THE *Scientific American* announces that Prof. Frank H. Bigelow, who recently resigned from the United States Weather Bureau, has joined the staff of the Argentine Meteorological Office.

WE learn from the *Times* that, owing to ill-health, Mr. Goodfellow, the leader of the British expedition to Dutch New Guinea, has been compelled to return home, and that the committee of the British Ornithologists' Union has appointed in his place Captain C. G. Rawling, who represents the Royal Geographical Society on the expedition.

THE death is announced, at fifty-three years of age, of Mr. F. Howard Collins, the author of "An Epitome of the Synthetic Philosophy of Herbert Spencer" and "Author and Printer: a Guide to Authors, Editors, Printers, Correctors of the Press, Compositors, and Typists." Mr. Collins was awarded a medal at the Franco-British Exhibition of 1908 for his "Simplified Mariner's Compass Card."

DR. HENRY WURTZ died recently at Brooklyn in his eighty-third year. At the beginning of the Civil War he was chemical examiner in the U.S. Patent Office, as well as professor of chemistry in the National Medical College at Washington. He was the author of numerous scientific treatises, and for some time editor of the New York *Gas Light Journal*. The mineral wurtzilite was named after him, and he was also the discoverer of the minerals huntilite and animikite.

A RECENT issue of *Science* gives an interesting account of the development of the Rockefeller Institute for Medical Research. The establishment of the institute is the culmination of a series of gifts, each one based on a demonstration of actual needs and on evidence of a wise use of previously available funds. The initial gift was made in 1901, when 40,000*l*. was provided to be used in a limited number of years in the form of grants to support research. In 1902 a donation of 200,000*l*. was received to cover the erection of a laboratory and the cost of current expenses for a few years. When the plans were being prepared for the future organisation of the institute, the necessity for having a hospital under the control of the institute was felt very much. Mr. Rockefeller decided to erect a hospital, and provided a further 124,000*l*. for the purpose. In 1907, while the plans of the hospital were being prepared, Mr. Rockefeller gave 520,000*l*. to be used solely for the endowment of the institute. This year the trustees of the institute assumed possession of 764,000*l*., the generous patron's latest gift. Up to the present time the work of the institute has been confined to laboratory studies of physiological and chemical aspects of diseases and to surgical and other problems that could be studied on animals. The need for the direct study of diseases under conditions that would permit accurate observations with the aid of comprehensive equipment led to the foundation of the hospital. Instead of being compelled to treat almost every kind of disease, as in a general hospital, the physicians will concentrate on a few ailments. The hospital will have physiological, chemical and biological laboratories to supplement those in the institute. The laboratories of the hospital will be devoted to investigations bearing on the diseases under treatment, while the laboratories of the institute will continue their investigations as conducted at present.

AT the last meeting of the Cotteswold Field Club Mr. L. Richardson pointed out that the so-called "stone circle" on Shurdington Hill, near Cheltenham, was really of natural origin. A slipping forward of the Upper Lias Clay was accompanied by undermining of the basal Inferior Oolite limestone, and some blocks rolling down the slope had assumed the appearance of a stone circle, which is so recorded in the Ordnance Survey. The site being under the cold shadow of a northward-facing cliff is not the position likely to have been selected for an interment.

AN interesting part of the work of the Brooklyn Institute of Arts and Sciences is the arrangement of a special museum and library for the use of children, of which an account is given in the report for 1909. The institution contains rooms devoted to exhibits of historical interest, geography, birds, insects, and similar objects. The library is provided with special literature on these subjects suitable to the needs of its students, and interest in the study of nature is excited by the issue of picture bulletins and the exhibit throughout the year of specimens of trees in bud, flowers, and fruits. The museum is said to be widely used by children in elementary schools, and it offers facilities for training of teachers, who are thus enabled to collect materials for study by their pupils. The practical system thus organised deserves the attention of school authorities in this country.

CAPTAIN A. J. N. TREMEARNE is busily engaged in unloading the stores of ethnological material which he has brought from Hausaland. He contributes to a recent number of the Journal of the Royal Society of Arts a series of folk-tales dealing with the relations of Hausa parents and children, which from these specimens seem to be far from satisfactory, these tales being devoted to the themes of unnatural parents and disobedient children. One is some-

what of the Sampson-Delilah type, in which a strong man loses his power through love of a woman. She, however, atones for this by allowing herself to be buried with his corpse, by which means she and her lover revive, and the grave becomes an iron house in which they live happily ever after.

So much discussion has arisen on the subject of eoliths that it is refreshing to find the case reviewed with good sense, knowledge of the conditions under which natural cleavage of flint may simulate the work of primitive man, and the provision of such a complete series of illustrations in the paper contributed to vol. xxi. of *L'Anthropologie* by L'Abbé H. Breuil, entitled "Sur la présence d'éolithes à la base de l'Eocene Parisien." We can only direct attention to this admirable essay, a study of which may be commended to certain enthusiasts on this side of the Channel. The same remarks apply to another contribution to the same magazine by M. G. H. Luquet, entitled "Sur les caractères des figures humaines dans l'art paléolithique," where the styles of this primitive art are illustrated by numerous well-selected sketches. The author is, on the whole, inclined to question the theory that a magical intention underlies the treatment of the sexual characteristics which are so prominent in the cave drawings.

Dr. Friederici, in describing the distribution of the sling in America (*Globus*, xcviii., p. 287), finds that it occurs practically everywhere if stones can be found. He seems to have misrepresented Peschel, who does not state (at all events in the English edition) that "slings cannot be used in tropical virgin forest," but that they "could not be used in the forest country of the Amazon," because, as he had previously stated, "no shingle is to be found." Slings could only be employed on the narrow paths, in clearings, or by rivers, but in such a country the bow is better than the sling; the spear-thrower is impracticable, as it requires so much elbow-room. He comes to the fairly obvious conclusion that the sling has been independently invented in various parts of the world.

In the Bulletin of the Johns Hopkins Hospital for November (xxi., No. 236) Dr. Harvey Cushing surveys the present status of neurological surgery, and shows how much has been accomplished during the last few years. Incidentally, Dr. Cushing deals with the value of experimentation on the lower animals. He says:—"There is no question but that a training for neurological surgery must come through laboratory experiences, and just as we are indebted to experimentation on the lower animals for almost every fact of importance which has made for the advance of this particular department, so also must we call upon them for the mere practice of hand essential to success in their clinical applications. Those who oppose the employment of animals for such purposes would leave us the only alternative of subjecting our fellow-man, as a lesser creature, to our first crude manipulations."

Ever since it was first discovered that sleeping sickness in Uganda was disseminated by the dusky tsetse-fly, *Glossina palpalis*, it has been a moot point whether or not other species of tsetse-flies are capable of transmitting *Trypanosoma gambiense*. The question is one of the greatest practical importance, since upon the answer it depends whether sleeping sickness is confined necessarily to those regions where *G. palpalis* is found, or whether it may spread over a vastly wider extent of the African continent into regions in which other species of tsetses occur. Prof. Kleine in German East Africa carried out some experiments with *G. morsitans* which led him to the conclusion that *T. gambiense* was unable to go through its development in, or be transmitted by, this species of tsetse (*vide* Sleeping Sickness Bureau Bulletin, No. 11, Appendix, and No. 18, p. 197). Recently, however, several cases of sleeping sickness have been reported from north-eastern Rhodesia and Nyasaland, from regions far south of the most southerly point at which *G. palpalis* is known to occur. It is believed that in these cases the transmitting agent is *G. morsitans*, and, if so, it is an extremely serious matter. It is to be hoped that the question will be thoroughly investigated without delay.

The seventy-fourth Bulletin of the United States National Museum consists of an account of some West Indian Echinoids, by Mr. Theodor Mortensen, of the Zoological Museum, University of Copenhagen. The memoir is a short one, extending only to thirty-one pages, but it contains a revised list of North American, Atlantic, and West Indian Echinoids, amounting to eighty-two species, which should be of great value to the systematist. The work is illustrated by seventeen plates of remarkable beauty.

As we learn from a recently published guide-book, by the curator, the exhibited series of British birds in the Hull Municipal Museum is of unusual extent and interest. It includes, for instance, a large collection made by the late Sir Henry Boynton, a second formed by the late Mr. H. J. R. Pease, and a third known as the Riley-Fortune collection. Two at least of these collections were found to supplement one another, and all three are rich in Yorkshire specimens. The guide is illustrated by reproductions from photographs of some of the groups.

Bird-marking is being carried on as energetically in the United States as in Europe, and, according to an article by Mr. L. J. Cole in the *Auk* for April, with equally satisfactory results. Open aluminium bands are now employed in place of closed rings, but these, owing to their hardness, are not altogether suitable for the purpose. Up to December 1, 1909, there were recovered 911 banded birds. Special interest attaches to a number of night-herons banded at Barnstable, Mass., of which a considerable proportion was recovered. After leaving the heronries these birds scattered in a northerly direction, this direction being largely due to the circumstance that there is no land to the south. The movement indicates, however, a tendency on the part of all young birds to disperse from the neighbourhood of the nests in which they were reared, owing to food-supplies having been rendered scarce.

The question whether bees are capable of distinguishing different colours has been much discussed, one observer maintaining that the varied hue of Alpine flowers is for the purpose of enabling bees to remain constant to a particular species of plant, so that pollination is effected to the mutual advantage of the bees and the flowers. On the other hand it has been argued that flowers might be as green as leaves without any hindrance to pollination by insects. To test the question, Mr. J. H. Lovell conducted a series of experiments with glass slides of different colours, rendered attractive by patches of honey, to see which particular kind bees would visit, a blue slide being, for instance, offered first, then a red one placed alongside, and, finally, the positions of the two exchanged. As the result of these experiments the observer states, at the conclusion of a paper in the November number of the *American Naturalist*, that "bees easily distinguish colours, whether they are artificial (paints, dyes, &c.) or natural ('chlorophyl') colours. They are more strongly in-

fluenced by a coloured slide than by one without colour. Bees which have been accustomed to visit a certain colour tend to return to it habitually—they exhibit colour-fidelity. But this habit does not become obsessional, since they quickly learn not to discriminate between colours when this is for their advantage."

IN his report on marine biology, included in the administration reports of Ceylon for 1909, Dr. A. Willey states that hopes have been entertained of rendering the southern division of the Mannar pearl-oyster fishery—more especially the so-called "Chilaw paars," which were the headquarters of the industry during the sixteenth century—once more productive. The results of recent observation tend to confirm Prof. Herdman's suggestion that most of the Mannar oysters are not bred *in situ*, but are carried by currents from the coasts of southern India—a conclusion which is of the most far-reaching importance in regard to the future of the pearl-fisheries. "Many years may elapse before anything like complete knowledge can be acquired concerning the physiology of the pearl banks. The great question which compels attention at the present juncture is that of the forced production and preservation of pearl oysters as against their natural propagation when left to themselves. It is felt that something must be done, and, from the rather misleading analogy of the edible oysters, that something can be done. And this conviction is fortified by the fact that something is being done with the same species in Japan, although it is probably a distinct local race adapted to a different environment. It still remains to be seen whether interference with the natural sequence of events will prove useful or profitable under the very special conditions that prevail in the Gulf of Mannar. It is only within the last few years that any attempt has been made to fathom the mystery by the accumulation of facts."

THE question of utilising wind power in country districts is so important that special interest attaches to the collection of statistics showing the frequency of winds of given velocities. In the *Agricultural Journal of the Cape of Good Hope* (No. 3) Dr. Sutton gives such a table for East London, and compares it with a similar table previously drawn up for Kimberley. It appears that at East London the wind is commonly too strong for the ordinary type of windmill; there is a vast amount of energy in the winds of the south-east coast of South Africa awaiting exploitation, but the mechanical difficulties appear to be great.

A NUMBER of determinations of the amount of arsenic present in soil, plants, fruits, and animals are recorded in a paper by Dr. Headden in the Proceedings of the Colorado Scientific Society, vol. ix. In the virgin soils examined no fewer than 2·5 to 5 parts per million were found, whilst the subsoils contained even more, sometimes as much as 15 parts per million. Orchard soils where arsenical sprays have long been in use may contain 10 to 28 times these quantities, and yield appreciable amounts of arsenic compounds to water. Crops grown on these soils and fruits from the trees all contained arsenic, and it was also readily detected in the urine of three persons who had eaten quantities of these fruits.

THE United States Department of Agriculture has of late been carrying out careful investigations on food and nutrition. Bulletin 227 deals with calcium, magnesium, and phosphorus in food and nutrition. It appears that a healthy man accustomed to a full, mixed diet requires for maintenance of phosphorus equilibrium about 1·5 grams of phosphorus, or nearly 3·5 grams of phosphoric acid, per diem, and the organic combinations of phosphorus seem to be best adapted for the purpose. The calcium requirement is equivalent to about 0·7 gram of calcium oxide per diem. Reference is made to the value of milk in supplying these requirements. The work has been carried out by Prof. Sherman and Messrs. Mettler and Sinclair, of the Department of Chemistry, Columbia University, and full details are given of the analytical methods and of the metabolism experiments. Circular 102 gives a list of the bulletins, &c., dealing with the subject issued by the Department.

CAPT. M. PISCICELLI contributes a well-illustrated article on Lake Bangueolo to the October *Bollettino della Società Geografica Italiana*, in the form of a letter to the secretary, dated at Abercorn, May 1, 1910. The hydrographical conditions of this great complicated maze of water, marsh and islands are described, with notes on the natives and on the fauna of the region.

MR. ELLSWORTH HUNTINGTON continues his investigations on the lines of his fascinating "Pulse of Asia." In the September number of the Bulletin of the American Geographical Society he analyses the data collected by Mr. H. J. L. Beadnell respecting the Libyan oasis of Kharga, and claims that they indicate a succession of climatical changes during the last 2500 years that are in close agreement with the hypothetical "pulsations" of climate in eastern and central Asia during the same period.

THE Liverpool Geological Society may be congratulated on the opening number of the eleventh volume of its Proceedings, which contains a spirited address by Prof. J. W. Judd, F.R.S., on "The Triumph of Evolution: a Retrospect of Fifty Years." Prof. Judd has always brought his personal knowledge of the pioneers of geology to aid him in stimulating research in newer generations. He has systematically upheld the claims of Lyell as an original observer, and as one of the masters who paved the way for the general acceptance of evolution in the natural world. In the present address the relations of Lyell and Darwin, and the final "triumph of evolution" resulting from the work of Darwin and Wallace, are pointed out with vigour and characteristic clearness. This part of the Proceedings also contains papers that maintain the high standard set by the society in the explanation of local geological features.

THE scientific investigation of the German colonial possessions in Africa proceeds steadily, and in the *Mitteilungen aus den deutschen Schutzgebieten* results are being regularly published. The last number (Heft. 3, Band 23) contains five articles dealing with German South-West Africa. One deals especially with the Auin, a Bushman tribe of the Middle Kalahari Desert, which occupy a district in the eastern boundary of the territory on the border of Bechuanaland. Their habits and customs, weapons, modes of hunting, games, and other information relating to this small tribe, which are said to number some 3000, are described and illustrated. A map on a large scale attached to the same number shows the position to the south of Kilimanjaro which has been set aside as a reserved territory for those of the Masai tribe who are on the German side of the Anglo-German boundary line. The reserve contains some 2500 square miles, and lies to the west of the Pangani River.

THE results of the magnetic observations made at the Central Meteorological Observatory of Japan during 1907 appear, and are discussed, in part ii. of the annual report now published. The observatory is situated at an altitude

of 21 metres in long. 139° 45′ E., lat. 35° 41′ N., and was rebuilt in July, 1897, great care being taken to exclude magnetic ingredients from the materials employed. The present valuable report gives a brief description of the building and apparatus, and also describes the methods employed in registering the different variations of the magnets. A number of tables give the hourly values, for the whole year, of the three elements, with remarks as to the nature of the variations, indicating storms, &c. A "severe storm" was registered during the morning of February 10, 1907, the magnets having been agitated during the preceding three days. The principal disturbances are shown on fourteen large-scale charts given at the end of the report.

THE first part of vol. ii. of the Transactions of the Royal Society of South Africa includes a paper by Dr. A. W. Roberts on a preliminary determination of the absorption of light by the earth's atmosphere. The paper is a brief statement of a single determination of the coefficient of atmospheric absorption made on the summit of one of the hills of the Winterberg Range, of an altitude of about 4000 feet. More than 500 observations were made, and it was hoped at first that these observations would yield both the coefficient of absorption and the height of the atmosphere, but a variety of solutions confirmed Dr. Roberts in the view that a more refined series of observations would be necessary before any trustworthy value of the height of the atmosphere would emerge from the equations. Dr. Roberts obtained as a final value for the coefficient of atmospheric absorption at sea-level 0·19 *m*, where *m* is the apparent magnitude of a star. The mean of the results obtained by Seidel, Langley, Pritchard, Muller, and Pickering is 0·21 *m*. Taking 0·20 *m* as a mean result, Dr. Roberts points out that this signifies that 17 per cent. of all rays that strike the atmosphere perpendicularly are absorbed by the atmosphere. On the horizon the brightness of a star is reduced so that it shines with only about one-fortieth of its zenith brightness.

PROF. EDGAR BUCKINGHAM contributes to the Bulletin of the Bureau of Standards, vi., 3, a short note on the definition of an ideal gas, embodying a brief statement of the main principles of thermodynamics associated with the definition in question.

ON February 21, 1911, the well-known firm of publishers founded by Benedikt Gotthelf Teubner will celebrate its centenary. In this connection a catalogue has been issued of recent works published by Messrs. Teubner dealing with scientific subjects, which affords a striking example of the influence which private enterprise can bring into play in the advancement of learning. Moreover, the list only deals with a small portion of the Teubner publications, separate catalogues being issued for literary and other subjects.

IN the *Rendiconto* of the Naples Academy, 5, 6 (May and June), Dr. Paolo Rossi describes observations on the double refraction induced by strain in caoutchouc. The principal conclusions appear to be that the difference of the principal indices of refraction is proportional to the tension, that the results are pretty much the same for vulcanised and unvulcanised caoutchouc, and that when the elongation is maintained constant the double refraction maintains its proportionality to the tension, even though the latter gradually decreases.

THE action of light on plants forms the subject of a note in *La Nature* for October 20 by M. H. Rousset, dealing with some recent experiments by M. Combes. The author points out that the effects of light vary according to the age and nature of the plant, a strong light favouring the development of large stores of reserve material, as in the tubers of the potato and in the beet, while a weaker light favours the growth of vegetative organs. The effect of light on the ova of trout is studied by Prof. Felice Supino in the *Rendiconti del R. Istituto Lombardo*, whose experiences tend to show that blue light is more favourable to the hatching and development of the ova than red.

IN the *Rassegna contemporanea* for October (a journal which, by the way, has during the past few months contained a number of well-written articles dealing with English national movements), Signor Gino Cucchetti publishes an article dealing, as the author claims, with a suggestion by the geologist, Venturino Sabatini, according to which a remedy for the disastrous effects of earthquakes in Messina and southern Italy should be sought in an efficient scheme of afforestation. It is pointed out that the cutting down of trees in such districts may frequently result in a loosening of the subsoil, which is largely argillaceous or sandy in character, thus giving rise to faults and lessening the resistance to the effects of seismic disturbances. The cutting down of woods receives further mention in an article by the deputy Giovanni Posadi dealing with the preservation of natural beauties, while an article by Signor Arnoldo Faustini dealing with changes that have occurred on the earth's surface in recent times, with special reference to the subsidence of the island of Bogoslaw, in Alaska, possesses collateral interest in the same connection.

THE report on the work of the Government Laboratories, Johannesburg, for the year 1908–9, has recently reached us. Whilst pointing to excellent services in the past, it gives evidence of the need for further inquiry into and control over the food and water supply of the district. The total population of the colony is about one and a quarter millions, including 300,000 persons of European descent; but only 158 samples of foodstuffs other than milk were examined during the year. This, as the analyst remarks, is very inadequate surveillance. As regards the water supply, that of Johannesburg was well looked after both chemically and bacteriologically; and that of Pretoria, where excellent water is obtainable, was also examined, though by bacteriological methods alone. But spasmodic attempts only have been made to control the condition of any of the other supplies of the colony by scientific means, and no proper systematic water survey has yet been made. Among other matters, it is noted that out of a total of 8526 samples examined, more than three thousand, mostly rats, were dealt with in connection with plague investigations.

THE contradictory results which have been obtained as to the effect of a magnetic field on the potential difference necessary to cause a discharge to pass between two electrodes in a rarefied gas are explained in a paper by Prof. Righi communicated to the Academy of Science at Bologna in May, and reproduced in the October number of *Le Radium*. The electrodes were about 2 square cm. in area and from 0·5 to 8 mm. apart, the gas having a pressure of a few tenths of a mm. of mercury. The difference of potential was provided by small storage cells, and the current transmitted measured by a galvanometer. The magnetic field in which the discharge tube was placed could be raised to 9000 units. Prof. Righi finds that the effect of the field, for strengths up to about 1000 units, is to diminish the required potential, but for greater strengths to increase it, and in the case of trans-

verse fields of still greater intensities again to diminish it. He considers these results point to the existence in the gas of neutral doublets, each consisting of a positively charged ion with a negative electron as satellite.

In an offprint from the *Atti del Reale Istituto Veneto* for 1909–10 Drs. R. Alpago and G. Silva discuss hourly observations of magnetic declination and dissipation of electric charge which they made at Padua on May 14–21. The magnetic observations agree with the more complete results from magnetographs in various parts of Europe in showing a small disturbance on the morning of May 19 about the time of the supposed passage of the earth through the tail of Halley's comet. But the coincidence might well be accidental, as magnetic conditions were disturbed for several days before and after. Electrical dissipation on May 19 was in no way outstanding. A very unusual feature throughout the observations is the absence of any decided difference between the rates of loss of positive and negative charges. For both the mean percentage loss observed per minute was 3·5, which is exceptionally high for the Elster and Geitel apparatus employed. There was a well-marked diurnal variation, again nearly the same for positive and negative charges. It showed a double oscillation. The two maxima, about 1.30 a.m. and 4 p.m., respectively, were not far from equal, and were more than double the principal minimum, which occurred about 8 a.m.

An illustrated catalogue of optical lanterns and accessory apparatus, and of an extensive series of lantern-slides to illustrate scientific and educational subjects, has been issued by Messrs. Reynolds and Branson, Ltd., of Leeds. Many of the slides may be hired as well as purchased. The catalogue shows that this firm has some 10,000 slides for sale or hire, and a list of 30,000 slides for sale only will be sent on application. In addition to slides illustrating most branches of science, we notice in the catalogue particulars of a very complete series of slides to illustrate school lessons in geography.

Messrs. W. and J. George, Ltd., of Birmingham, are issuing their latest illustrated catalogue of scientific apparatus in sections, each dealing with a specific group of science subjects. We have received sections 1–4 bound in one volume and sections 5–7 in a second. Copies of the catalogue will be sent on application to teachers and lecturers in charge of laboratories, and to other purchasers of apparatus. The lists are profusely illustrated, and so arranged that reference is easy. The information provided is thoroughly practical, and will assist the teacher greatly in the choice of instruments.

Mr. W. H. Harling, Finsbury Pavement, London, is issuing in parts the fourteenth edition of his catalogue of mathematical drawing instruments and materials. Section A, forming the first part of the full list, has reached us, and gives particulars of the drawing pens, half sets of compasses, bow compasses, spring bows, and proportional, beam, and pencil compasses which are manufactured by this firm. We have also received from Mr. Harling a specimen of the set-square guide he has just produced. It is a simple contrivance in pearwood for guiding a set-square from any edge of a drawing board or sketch block. The guide should be convenient for rapid field sketch work and useful for section lining and cross-hatching. The price of the guide is 1*s*. 6*d*.

The report of the council of the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne for 1909–10 shows that the membership has suffered a net loss of eighteen during the year, having fallen to 395. The society's work, especially in connection with the maintenance of its museum, has been helped greatly by the Crawhall bequest of 6000*l*., which has been so invested that it yields an annual income of 200*l*. Without this timely aid the position of the society would be serious, and it is difficult to see how some such exceptional source of income could have been dispensed with, for in some respects the society is not so flourishing as the council wishes to see it. An issue of the Transactions of the society has been published during the year, and the concluding part of the third volume of the new series is nearly ready. The usual series of winter lectures and summer field meetings have been held. The average attendance at the evening lectures was 85, at the children's lectures 164, and at the curator's "talks" 53.

OUR ASTRONOMICAL COLUMN.

Recent Fireballs.—There was a brilliant meteor seen on Sunday, November 20, by Mr. and Mrs. Wilson, of Cheshunt, Herts, and by Mr. C. B. Pennington, of Newark. It passed over the North Sea east of Spurn Head at heights of from 73 to 33 miles. Its motion was exceedingly slow, being about 12 miles per second.

On Friday, November 25, about 7.30, a fine meteor was seen at Weston-super-Mare by Mr. J. Hicks. He was using a telescope at the moment, but a bright light caused him to look upwards, when he saw a fireball travelling in the direction from Saturn to two degrees above Altair. Near the end of its luminous flight it broke up into a string of fragments like first-magnitude stars, and went some distance farther. The same meteor was seen at Bristol travelling from between Saturn and α Arietis through the stars of Pegasus. It threw off a brilliant train of yellow sparks, and the nucleus distributed itself into a stream of particles at the end. The height of the object seems to have been from 88 to 41 miles from Portland Bill to Launceston, and its path about 93 miles at a velocity of 23 miles per second. The radiant was at about $64° + 21°$. Another but smaller Taurid was observed on November 25 at 6.52 at normal heights above Somerset, and it moved with great slowness, the speed being about 14 miles per second.

During the progress of the eclipse on November 16, at about 12h. 24m., a splendid meteor was observed from Ireland and Scotland. It had a long and rapid flight, and left a bright streak for several minutes. According to an observer near Glasgow, the meteor was apparently as large as the moon. The descriptions prove that this fireball was a late Leonid. It passed from over a point a few miles west of Glasgow to over the sea north of the Irish coast in a direction almost east to west. The heights were about 89 to 48 miles, and the length of path 145 miles.

Saturn's Rings.—Circular No. 129 from the Kiel Centralstelle contains a telegram from M. Jonckheere, of the Hem Observatory, stating that, on several evenings, he has observed a nebulous degradation of the exterior edge of the Saturnian ring A.

Cerulli's Comet (1910*e*) identified with Faye's Short-period Comet.—In a communication to the *Astronomische Nachrichten* (No. 4456) Prof. Pickering gives the elements, and an ephemeris, calculated by Mr. Meyer Lewy, for Cerulli's comet, and points out the probable identity of this object and Faye's periodical comet; such identity was also suggested by Prof. Berberich.

Dr. Ebell, having investigated the subject, finds that the observed place on November 12 differs from the calculated place of Faye's comet by only -4s., $-4{\cdot}1'$, whilst the present apparition is the most favourable and brightest since the object was discovered by Faye, at Paris, in November, 1843; he considers the identity is assured. A later telegram Prof. Pickering gives improved elements and ephemeris by Mr. Lewy, and states that the identity with Faye's comet is confirmed.

Faye's comet has a period of 7·44 years, and was re-

discovered in 1850, 1858, 1866, 1873, 1880, 1888, and 1895, although it was missed in 1903. Its orbital eccentricity is exceptionally small, and its perihelion distance (1·7) great. It is also remarkable as being the first comet of which the periodicity was determined, by Goldschmidt, directly, by calculation, without comparison with the elements of earlier comets.

A number of observations are also published, the magnitude being generally estimated as about 10. Dr. Schiller recorded it at Bothkamp on November 10 as diffused, having a suspicion of a tail, in p.a. 300°, and a granulated nucleus of magnitude 9·8. Dr. Ristenpart, on November 11, saw no tail, but an eleventh-magnitude round nebulosity of 1′ diameter with a central condensation. Dr. Cerulli announces that he discovered the comet on a plate taken on November 8.

A System of Standard Wave-lengths.—No. 3, vol. xxxii., of the *Astrophysical Journal* contains a list of forty-nine secondary standard wave-lengths published under the auspices of the International Union for Solar Research. The increased accuracy of modern research necessitated the measurement and adoption of a standard system, and to this end three independent observers were asked to determine the wave-lengths of the forty-nine iron lines now published. From the results secured for each line a mean value has been adopted, and will in future be used in solar work; the wave-lengths range from λ 4282·408 to λ 6494·993, and wave-lengths measured in this system should be designated in future by using the symbol "I.A." The primary standard is the wave-length of the red cadmium line adopted at a previous conference.

In the same journal Prof. Kayser publishes standards of third order of wave-length on the international system, determined from the arc spectrum of iron between λλ 4118 and 6494; he intends extending the measurements to λ 7900. He finds that some of the secondary standards still contain errors of from 0·004 to 0·005 A. A comparison with Rowland's wave-lengths of the solar spectrum gives differences varying irregularly between 0·15 and 0·22 A., but by subtracting about 0·19 A. from Rowland all measurements can be reduced to the international system with sufficient accuracy. Prof. Kayser tabulates about 370 wave-lengths, and gives the intensity, the probable error, and the respective differences from Rowland and the observers who made the measurements for the secondary standards, viz. Fabry and Buisson, Eversheim, and Pfund.

The Radial Velocity of Sirius.—A most exhaustive discussion of the radial velocity of Sirius is published by Herr W. Münch in No. 4455 of the *Astronomische Nachrichten*. Herr Münch measured a large number of plates taken at Potsdam during the period 1901–10, and his thorough discussion takes up the whole of a double number of the journal. It includes, *inter alia*, the errors introduced by the measuring screw, by the different widths of the measured lines, by the possible uncertainty as to the purity and wave-lengths of some of the lines, &c. Besides several lines of yet unknown origin, he finds in the spectrum of Sirius those due to Cr, Fe, H, Mg, Ni, Sc, Ti, V, Y, and Zr, and, possibly, La and Mn.

For the mean velocity of the centre of the Sirian system referred to the sun he tabulates a series of seventeen values ranging from −8·0 (March 17, 1907) to −14·1 (April 4, 1906), the mean value being −10·3 km., with a mean probable error of ±0·4 km. Omitting the observations of 1906 and 1908, which gave abnormally large values, the mean radial velocity becomes −9·8 km., with a mean probable error of ±0·3 km.

"Annuaire du Bureau des Longitudes, 1911."—The *Annuaire* for 1911 published by the Bureau des Longitudes contains the usual astronomical tables, ephemerides, &c., and also tables relative to metrology, moneys, geography, meteorology, and statistics; this year the tables of chemical and physical data are omitted, as also are matters referring to the sundial, solar physics, and the minor planets.

The special articles, four in number, are very interesting; the first deals with the sixteenth conference of the International Geodetic Association, which was held in London, and in the second M. Bigourdan publishes a great deal of interesting information concerning the total eclipse of the sun which will take place on April 17, 1912, and will be visible in France for a few seconds.

Magnitude of Nova Sagittarii, No. 2.—A telegram from Dr. Ristenpart, Santiago, announces that on November 7 the magnitude of Nova Sagittarii (96.1910) was 9·9 (*Astronomische Nachrichten*, No. 4456).

AGRICULTURAL RESEARCH IN JAPAN.[1]

The Japanese have entered the field of agricultural investigation with characteristic energy and thoroughness, and have shown a lively appreciation of the fact, not always realised elsewhere, that the principles underlying an agricultural problem must first be studied before the problem itself can be solved. Some of the special features of Japanese agriculture present highly important problems, the development of which will be awaited with much interest.

The present volume of the Journal of the College of Agriculture contains, in the two parts already published, four papers, of which three deal with silkworm problems. Mr. K. Toyama reports studies on the red worms occasionally appearing among the progeny of the normal black worms, and hitherto regarded in a general way as sports. In 1905 he obtained some red worms, and studied their behaviour on crossing. The results showed that the phenomena are really Mendelian, black being dominant over red; the red worms uniformly yielded red offspring, while the matings of the blacks resulted in the production of one red to three blacks. Prof. C. Sasaki deals with jaundice of the silkworm, a disease prevalent in all silkworm countries, and frequently found in Japan. The worms lose their appetite, weaken, and finally die; the skin loses its firmness and becomes soft and weak, while polyhedral bodies appear in the blood and various tissues. Evidence is adduced that the disease is caused by a streptothrix found in the blood of affected worms. The polyhedral bodies may, however, arise from other causes such as a small dose of formalin, interruption of respiration, or attacks of maggots, and are probably to be ascribed to the degeneration of the contents of the nucleus. The same author has also solved an interesting problem that has hitherto been overlooked. Silk fishing lines, commonly known as "Tegusu," are largely employed by the Japanese fishermen, but no one has up to the present found out any more about their origin than that they are imported from southern China. The Chinese writers say that some wild silkworms found in Yōkō on the leaves of camphor trees and Foushu (*Liquidambar formosana*) are the source. In April, when the worms are mature, they are dipped in vinegar, and then filaments 7 or 8 feet long and golden-yellow in colour are taken from their bodies. Prof. Sasaki made a journey in southern China, found the worm, and determined it as the larva of *Saturnia pyretorum*, Westwood. He has also introduced it into Formosa.

Mr. S. Kusano has a paper on chemotactic and similar reactions of the swarm spores of myxomycetes, Æthalium, Stemonitis and Comatricha being investigated. In general, these organisms feed mostly on rotten wood or leaves, and there is evidence that they can digest bacteria. It appears also that they can themselves be devoured by infusoria. Wood attacked by them was found to be acid. The swarm spores showed marked chemotaxis, being attracted by acids, repelled by alkalis, and unaffected by neutral, non-poisonous substances. A consideration of the phenomena from the dissociation hypothesis indicates that the H- and OH-ions are in all cases the stimulating components, the OH being much the more effective, and active even at a dilution of N/10,000. The attraction of the H-ion reaches a maximum at N/600; in higher concentration the acid repels and injures the organism. H-ions act beneficially in several ways; they promote germination of the spores, and then attract them to the place where food material occurs. An interesting physiological point was noticed. The spores germinate much more readily in contact with moist air than when thrown on to water; in the latter case they do not appear to be wetted very quickly.

1 Journal of the College of Agriculture, Imperial University of Tokyo, vol. ii., Nos. 1 and 2.

STOCKHOLM TO SPITSBERGEN: THE GEOLOGISTS' PILGRIMAGE.

WE geologists who were privileged to take part in the journey to Spitsbergen before the meeting of the Geological Congress in Stockholm had good reason to count ourselves fortunate. Perfect weather, genial companionship, comfortable surroundings, admirable organisation and guidance, and a route through the strongholds of Thor of the Hammer, in which intense scientific interest was constantly united with entrancing beauty of scene—surely the combination would have roused enthusiasm among much more stolid folk than the impressionable race of hammerers!

We started by special train from Stockholm, about seventy strong, an agglomerate of fifteen nationalities, on the evening of July 25, and at once left behind us the broken weather that has encircled Western Europe this summer, entering a northern region of brightness and calm in which we continued until our return. Those of us who were in Stockholm the previous day had been called together to see a fine exhibition illustrative of Spitsbergen geology, temporarily shown in rooms attached to the museum of the Swedish Geological Survey, and to hear lucid demonstrations on the exhibits by Prof. A. G. Nathorst and by the Director of our excursion, Prof. G. De Geer. Here we had already an opportunity to begin or to renew friendships that were cemented during the journey. Owing to the care and forethought with which every detail of the expedition had been planned, our start was made promptly, and we settled without confusion into our allotted places.

The night's train journey brought us to Ragunda in Ångermanland, where our first halt was made. During four hours of the morning we visited sections splendidly illustrating the evidence from which Prof. De Geer has worked out the chronology of post-Glacial time in Sweden. By a catastrophe in 1795, the great lake of Ragunda was suddenly drained and its bed laid bare; and the ravines subsequently eroded through its sediments now reveal the whole succession deposited since the melting of the Glacial ice-sheet. In these sediments Prof. De Geer recognises and counts the annual bands of the "seasonal clays," much as one may count the annual bands in a tree trunk. By the extension of the same method over various other parts of the country, he has attained results by which the recession of the ice-sheet and all its incidents may be actually dated, as he showed us later in field demonstrations near Stockholm during the sitting of the congress.

Northward again for the rest of the day and through a night of twilight, during which the Arctic circle was crossed, our train brought us to breakfast on July 27 at the bright town of Kiruna, which has newly sprung up in the Lapland wilderness under the famous mountain of iron ore. Here we remained until the afternoon, visiting the great iron quarries under the guidance of Director Hj. Lundbohm, who instructed us by a preliminary address in the geology of the district and the history of its rapid development. After a banquet to which we were invited by the mining company we took train again at 4 p.m., and ran shortly into view of the beautiful Lake Torneträsk, in a region of powerful overthrust faults and of Glacial lake-shores. Making several short halts in this wild country to examine points of especial interest within easy reach of the railway, under the guidance of Dr. O. Sjögren, we reached Abisko in the evening. Here our train remained for the night, affording us opportunity to appreciate the picturesque surroundings of Abiskojokk, now a much visited tourist resort.

On the morning of July 28 the Norwegian frontier was reached at 11 a.m. Thereafter followed a marvellous descent to the coast, along the rim of a great fiord the blue waters of which shone gloriously in the depths below us. At Narvik, our port of embarkation, we were shown the methods of treating the iron ore from Kiruna and the facilities afforded for its shipment, being thereby still further impressed with the enterprise which has been shown in the development of this great Swedish mining industry.

Our ship was the *Æolus*, Captain S. de Klinteberg, a comfortable Stockholm passenger boat of 870 tons register. Sailing from Narvik at 5 p.m., we were held up for a few hours of the night by fog in the narrow passages leading northward from the Ofoten Fiord; but this was our only delay in the charming voyage to Tromsö, which was reached next evening.

There had been rumours of unusual ice conditions in the Spitsbergen seas before we left Stockholm, and at Tromsö these rumours were partly confirmed. Our Director, therefore, learning that a French ship was due to arrive next day from the north, decided to await her coming in order to gain definite information. So we spent a calm, sunny day pleasantly at Tromsö, first visiting the museum with its excellent collection of Arctic animals and birds, and afterwards crossing to the mainland to see the Lapp summer camp or to climb the nearer mountains. Meantime the *Ile de France* had arrived, and reported that while floe-ice from Barents Sea had drifted in quantity round the south and south-west coast of Spitsbergen, the inner fiords of the island were free, so that the only difficulty was to obtain access to them, for which purpose it might be necessary to go far to the westward. With this intelligence we steamed ahead again on the evening of July 30.

As we passed northward in the shadow of the fiords a red glow of wonderful brilliancy shone on all the higher peaks and glaciers, and never faded; until, at midnight, as we passed out into the open ocean under the majestic Fugle Rock, we saw the disc of the sun just cut by the sea-line; from which it rose with seeming effort, like a heavy seabird, as night grew into morning. It was thus that most of us gained the midnight sun for the first time, not to lose it again until our approach to Norway in returning.

During the last day of July we pounded northward under a cloudy sky, with a touch of ice in the air; but in the evening we ran into sunshine again, and there, ahead of us, lay Bear Island miraged on the horizon. This was indeed good fortune, for in his eleven previous voyages past the island our Director had seen it only twice, so frequent are fogs in these seas. Our course was altered that we might run in under its eastern face. The placid sea around us was furrowed by its myriad sea-fowl, and from 11 p.m. until 2 a.m. we coasted its lonely cliffs and sea-stacks closely enough to distinguish the main features of their geological structure, and to catch glimpses of its desolate interior with all features accentuated by the light and shade of the low sun.

In its stratigraphy Bear Island is akin to Spitsbergen, though with a more restricted range of formations. To all geologists these far northern islands are of great interest, but peculiarly so to the geologists of Scandinavia, inasmuch as they contain a great sequence of the later Palæozoic, Mesozoic, and Tertiary sediments which are lacking within the Scandinavian 'shield.' To the Swedish explorers, and especially to Prof. J. G. Andersson, we owe most of our knowledge of the geology of Bear Island. At its southern extremity is a ridge of crushed and altered 'Heklahoek' rocks, which include fossiliferous Lower Silurian limestones. The rest of the land is built up of Devonian, Carboniferous, and marine Triassic strata, all in some parts very fossiliferous, and with coal seams in the Devonian. The sequence is interrupted by strong unconformities and broken by faults, some of which we could see plainly from our steamer.

Now it became difficult to chop up the Arctic day into conventional night and morning, and we counted by events—particularly by meal-times, for we were a hungry crew—rather than by the clock. Not many hours after sinking Bear Island in the southward, on August 1, we began to meet floe-ice; which soon thickened, so that we had to slow down and eventually to turn southward and westward for more open water. Again and again during the day was this experience repeated, a chilly ice-blink always paling the hazy sky to the north and east as we threaded our zigzag course amid the floes, on which inquisitive seals shifted uneasily, doubtful whether to regard us as dangerous or not. Usually at this season the voyage to Spitsbergen lies entirely in open water; but most of us were glad of the chance which gave us this touch of the true Arctic colour. Still, to the anxious captain of our ship the prospect must have been decidedly less enjoyable. Thus we steamed cautiously all day and all night among the floes or along the broad water-lanes between the great white streaks drawn out by the north-flowing

current, until we had been shouldered off 70 or 80 miles to the westward of Spitsbergen. On August 2, however, we got an easterly course, picking our way across the ice-streams where they were thinnest, and by evening the lead showed that we were approaching land. So we lay to, in a light haze, to await clear weather.

Soon, very gently, the haze thinned away; the northern sun shimmered again over the smooth olive sea, burnishing the floes into silver; and then, gradually, an exquisite panorama of peaks and glaciers was unveiled in front of us, lengthening northward and southward into a far perspective, and we knew that this was Spits-bergen, and worthy of its name. Due north of us rose the angular ridges of Prince Charles Foreland, and right ahead lay the gap of our haven, Ice Fiord; so we moved quietly forward, through a scene of dreamy splendour, to our anchorage after midnight in Safe Bay. Surely never was there a more impressive revelation of this silent land!

From this time onward our days were busy days, thronged with scientific interests and impressions that shifted all too rapidly. Within the great Ice Fiord, which runs for 60 miles eastward, crossing the strike of the rocks and almost bisecting the island, we found open water, and our ship was able to pass into all its branches without impediment. During the ensuing week we penetrated most of its recesses, landing at the best points for investigating its several formations, and gaining a clear idea of their structures from the barren craggy outcrops that rose high above all the waterways. (See Fig. 1.)

Though complex in detail, the geology of central Spitsbergen is simple in its main outlines. Earth-movements of intensity, repeated at intervals down to Tertiary times, have ridged up the western margin of the island, bringing to light the oldest rocks and crumpling them along with the newer formations. These earth-waves, with their faults, folds and overthrusts, subside eastward, leaving a high plateau of regular stratigraphy and gentle dips, which is sharply trenched by the branching fiord and its tributary valleys. On the north side of the fiord most of the valleys contain glaciers which reach the sea; but on the south side, owing to difference of aspect and other causes, the land-valleys are often empty nearly to their heads.

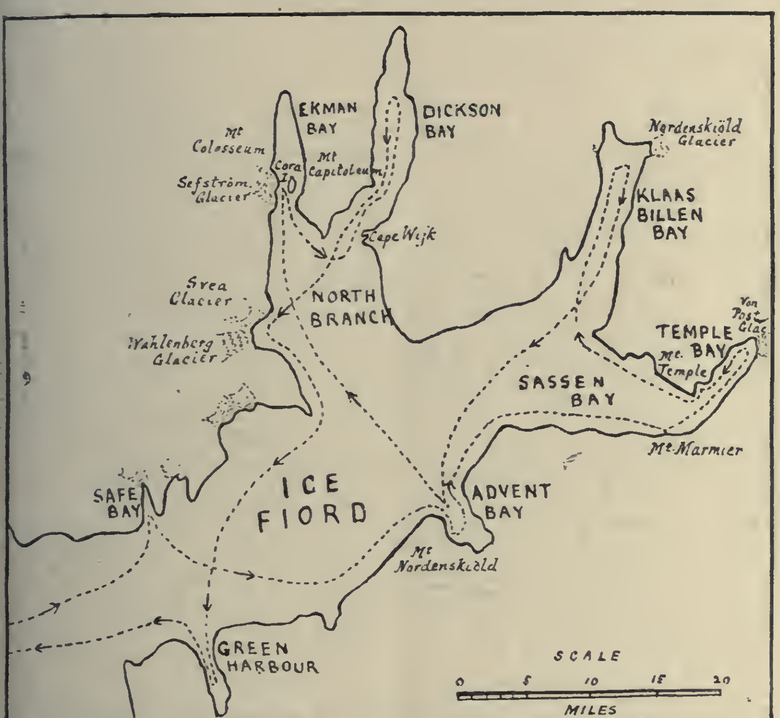

FIG. 1.—Index-map of Ice Fiord, Spitsbergen. The course of the ss. *Æolus* is shown approximately by the dotted line.

The high jagged outer ridge, at the entrance to Ice Fiord, consists of crumpled Heklahoek rocks, succeeded eastward in the next ridges by sharply folded and broken Carboniferous strata. But in the interior, the long northern branches of the fiord reveal a great mass of red Devonian rocks, very similar to our British Devonian, upon which the Carboniferous strata rest with strong unconformity and overlap. In upward succession, the Carboniferous limestones and cherts are followed by a belt of sandstones and shales, to which, on the somewhat scanty fossil evidence, a Permian age is assigned; and above these come the Triassic strata, chiefly shales or clays, with thin limestones, sandstones, and phosphate-bands, often rich in well-preserved marine fossils. The outcrops of the three last-mentioned formations are narrowed to strips in the outer folded belt, but expand into wide tracts around the interior fiord. Then follow thick masses of the Jurassic and Tertiary sediments, for the most part gently dipping and in apparent, but unreal, conformity, which build up the high picturesque plateaus on the south side of the inner fiord. These consist mainly of sandstones and shales of fresh-water or estuarine origin, but with occasional bands containing marine fossils. Both formations yield abundant well-developed plant-remains, in striking contrast with the present diminutive Arctic flora; and both include coal-seams, at least one of which, in the Tertiary rocks, is likely to be of economic consequence.

To resume the recital of our doings in this land. We were astir early on the morning of August 3, anxious to take our first steps in Spitsbergen, and before breakfast many of us were ashore among the mixture of rocks, moraines, glaciers and raised beaches that forms the west shore of Safe Bay. Leaving this anchorage at breakfast time, our ship went east across Ice Fiord and ran close in under the bold precipices of Jurassic and Tertiary rocks bounding the plateau around Mount Nordenskiöld, until Advent Bay was reached, before noon. This has recently become a place of permanent habitation—the only one in the ownerless land. Most of us were surprised at the display of engineering activity in such a remote corner, brought about by American enterprise in the development of a mine in the Tertiary coal. A shipping wharf has been erected, to which the coal is brought from the mine high up on the hill-side by skips travelling overhead on a cable. At the mine, which we visited later, a seam of good quality, 4 feet thick, is worked by means of an adit. It was singular to see the walls of the workings all thickly encrusted with a sparkling layer of hoar-frost from the condensation of moisture on rock-surfaces that are permanently below freezing point. A pure white coal-mine!

For the afternoon in Advent Bay we divided into two parties. Those who wished to study the Jurassic plant-beds crossed with the ship to the north-east side of the inlet under the guidance of our Director. The rest of us landed at the wharf and went inland towards Mt. Nordenskiöld, led by Mr. B. Högbom, who had been already for some weeks in the island on geological work under Prof. De Geer's instructions, and who here awaited us. With him we went to the glacier-filled head of the valley south of the coal-mine and ascended the plateau on the westward to an upper moraine where Tertiary plant-fossils occurred in profusion. On this moraine, at an elevation of about 1500 feet, most of us were content to stay, basking in the sunshine and enjoying the glorious view over fiords, plateaus, and snow-fields; but certain of the more energetic elder members of our party continued upward

over the snow to the very summit of Mt. Nordenskiöld (3460 feet), not reaching Advent Bay again until near midnight. The plateau which we traversed in returning to the ship was tesselated in places with fine examples of the singular "gardens" due to soil-creep—round or polygonal patches of clayey soil, up to 15 feet in diameter, bordered by slabs of stone, often on edge—which are remarkable in the Spitsbergen tundras at all levels, as in those of other Arctic lands.

Leaving Advent Bay at noon on August 4, our course was shaped eastward under the cliffs to Sassen Bay, where we made a short landing near Mt. Marmier to collect the abundant Triassic fossils and to examine the diabase which is here intruded conspicuously in sheets among the sediments. It was instructive to see how the shaly Trias, very like our Lias in composition, was creeping down the slopes in big partly frozen mud-flows, mixed with ice and with blocks of diabase, providing a mass ready to be worked up by any advancing glacier into the semblance of our darker boulder-clays. This, indeed, is the particular value of the Spitsbergen phenomena to the English glacialist, that the country rocks are analogous in structure and texture to those of England, and are rarely of the hard type prevalent in nearly all other accessible regions of present-day glaciation.

Crossing Sassen Bay, we landed our palæontologists at Cape Bjona, under the fluted cliffs of Mt. Temple, for the collection of Carboniferous fossils from the inexhaustible stores of the limestones. The glacialists then went on with the ship to the head of Temple Bay, where the Von Post Glacier comes down to the sea with a front of ice-cliffs three miles broad. This glacier is now in retreat, and lateral moraines of its former extension line the fiord on both sides for a distance of more than a mile from the present front. Ice-falls from the glacier into the sea cause waves that have carved out cliffs 30 or 40 feet high in places, clearly revealing the composition of the moraines. These cliffs were strikingly similar to those of some English boulder-clays; indeed, but for the gleam of the neighbouring ice, one might have imagined oneself under a sea-cliff of north-east Yorkshire. The red loamy clay of the sections was studded, not too abundantly, with well-striated boulders of igneous and metamorphic rocks (from some unknown source beneath the glacier) along with others, more numerous, of grey and red sandstones, conglomerate, chert, Carboniferous limestone, and other sedimentary rocks. Both moraines formed broad hummocky ridges, with troughs of lower ground behind them.

A party of five German explorers, under the leadership of Lieut. W. Filchner, who were intent upon a journey into the interior of Spitsbergen, had been with us up to this point, interesting us greatly by the preparation of their outfit during the voyage. Now, with a heartening cheer, we left them to begin their adventures, our ship returning in the quiet evening sunlight for the night's anchorage at Bjona Harbour, where the impatient palæontologists hungrily declared that we were trying to starve them into glacialism!

Next day we coasted eastward to Klaas Billen Bay, and then northward up this deep inlet nearly to its head. A new phase in the stratigraphy of the island was here most instructively displayed in its bare brightly tinted slopes. Red Devonian strata rose up in strong force on its western side until unconformably overlain by the "Culm," which is believed to be of Lower Carboniferous age, while the limestones and cherts of the Upper Carboniferous rested in still bolder unconformity on both. A great fault cuts out the Devonian at the head of the bay; and east of it the Carboniferous rocks are known to rest directly upon bosses of an ancient complex group assigned to the Archæan, which we had not time to reach. Under the instruction of our leader these complicated features were made plain to us from the ship, and we realised how great was our advantage in gaining so comfortably in an hour the knowledge that would have cost many laborious days to gather without such guidance. Most of the day was spent on shore at the western side of the fiord; then, after a late dinner on the ship, we went to land again at 10 p.m. on the eastern arm, for a midnight stroll to the Nordenskiöld Glacier, which breaks off with a sea-front of three miles in water reaching nearly 500 feet in depth. Under an overcast sky, which intensified the cold blueness of the ice, we crossed the tesselated tundra with its shelly terraces of raised beach to the southern moraine of the glacier, and saw how the grey shelly mud had been incorporated with the moraine. This was our coldest night, with no sun; but we were fortified by a camp-fire on the beach, and hot coffee, before returning to the *Æolus* at 2 a.m.

An incident of navigation had rendered it necessary that our ship should return to Advent Bay for a further supply of coal, so now she went southward across Ice Fiord to the coaling wharf, and lay there during August 6. Here, for the day, our party broke up into independent groups, some climbing the high plateaus, others going up the coalmine valley to the glaciers, and the palæontologists working assiduously along the Jurassic and Tertiary outcrops on the slopes above the bay. Next morning we left Advent Bay again for the North Branch of Ice Fiord; passing from cloud and breeze into bright still sunlight, with that local incidence of weather which appears to be characteristic of Spitsbergen, for all day we could see the cloud-banks pouring in like great glaciers from the ocean and welling up against the southern shore of the fiord.

Entering Ekman Bay, we passed along under the ice-cliffs of the Sefström Glacier, and anchored at a spot which quite recently was beneath the glacier. Above us, on opposite sides of the bay, rose the exquisitely fretted edges of Mt. Colosseum (1960 feet) and Mt. Capitolium (2790 feet), built up of nearly level Carboniferous rocks in tier after tier of belted crags, separated by high-pitched slopes and notched with amazing regularity by gullies and talus-cones (Fig. 2). We had seen similar features again and again during previous days, but here the sculpturing attained its greatest beauty, and the rhythm of light and shadow under the low sun gave a well-nigh perfect impression of architectural design. It was just the typical sculpturing of an arid climate, reminding us of scenes in the 'Bad Lands' and cañons of western America. In Spitsbergen, also, there is not sufficient precipitation to maintain permanent streams except those that have their source in melting snow and ice, so that the cones of frost-riven talus everywhere accumulate on the bare slopes above the over-deepened main valleys.

As for the Sefström Glacier, it afforded us a series of lessons of surpassing interest. When first mapped by Prof. De Geer in 1882, the sea-front of this glacier lay two or three miles back within its side-valley; and was flanked on both sides by fluvio-glacial outwash plains. Between that time and 1896, when it was again examined by our Director, it had advanced about four miles, burying the outwash plains, filling its valley up to the mountain slopes, and bulging out into Ekman Bay in a broad lobe that reached across to Cora Island, hardly a mile from the opposite shore of the bay. But its spurt was over; already in 1896 it was sinking back; and when visited in 1908, though its detached snout still hung grounded on Cora Island amid huge masses of morainic material, the main front had so far receded that there was again a sea-passage between it and the island, and a narrow strait, with ice-cliffs to right and left, between the new front and the detached portion affixed to the island. Since then there has been further recession, so that we found a wider passage; but a remnant of the melting snout still shone up conspicuously amid the red moraine on Cora Island.

We spent most of the day on the island, and I know that there was at least one glacialist of the party who felt that the time of the whole journey would have been well spent for the sake of this day alone! In its original condition Cora Island was a low spit about two miles long and half a mile or more wide, composed of Carboniferous limestone partly covered with raised beach; but it has been increased to more than twice its size by the moraine banked upon its western side during its invasion by the glacier. This moraine, which for the greater part must have been actually under the ice at its maximum, has been thrown in a tumultuous succession of ridges and hollows across the flank of the island, forming a curved belt about three miles long, nearly half a mile wide at its broadest, rising in places to 50 or 60 feet above sea-level, and ending sharply, where it touches the original island,

against the lower bare ground, with hardly any 'outwash' (see Fig. 3). It consists almost entirely of streaky red clay containing a few scratched boulders, and crowded with marine shells, some broken, but mostly perfect and the bivalves united. The clay has evidently been derived in the first place from the red Devonian rocks into which the fiord is cut; but its more immediate origin was the neighbouring sea-bottom, which has undoubtedly been dragged up in some way by the glacier in its advance. The existing remnant of the glacier was seen to be curiously entangled among the clay; and the presence of smaller masses of ice buried under the moraine was indicated by the crater-like hollows of subsidence by which its surface was pitted.

But the story of Cora Island is too long for our space—we must leave it regretfully, in the same mood that we left it on the late evening of August 7, to hasten back to our ship. On August 8 the *Æolus* carefully threaded the

different temperament; the Svea, smooth, worn, and retiring; the Wahlenberg, known to have been recently aroused into activity, and jagged, fissured, and tumbling in the rapidity of its advance. On this coast, also, our Director pointed out to us the crumpled structure of the rocky ridges separating the glacier-basins—huge wrinkles on the fringe of the western belt of disturbance. Crossing Ice Fiord once more, we found anchorage for the night in Green Bay, but not too near the malodorous whaling station, where the carcases of a dozen unshapely monsters awaited dismemberment.

On the morning of August 8 we landed on the west shore of Green Bay, and went inland up a transverse valley which cuts the mountainous ridge and very clearly reveals its structure—a steeply dipping succession of Carboniferous, Permian and Trias, with Jurassic on the shores of the bay, and Tertiary, comparatively undisturbed, above the eastern side. Mist, with a splutter of rain, hung around

Photo. by Oscar Halldin, Stockholm.] [*Reproduced by kind permission of Prof. G. de Geer.*

FIG. 2.—Mount Capitolium (2790 feet), Ekman Bay. Carboniferous rocks (with underlying Devonian concealed by talus), showing fretted form developed by weathering.

inner recesses of Dickson Bay, where her farthest north, 78° 50′, was reached, and where the glowing redness of the Devonian rocks—in the distance like heather in bloom—gave warmth to the Arctic wilderness. Many of us, however, chose the alternative of a landing under Cape Wijk, at the entrance to the fiord, and a long climb up the shaly slopes of Permian and richly fossiliferous Trias to the plateau at about 2000 feet, formed by an intrusive sill of diabase. There, in bright sunshine, we gained a view from which not all the promised reptiles of the Trias could drag us—fiords, glaciers, and valley-trenches everywhere around; away in the north-east, snowfields and peaks above the head of Wijde Bay; and our ship a speck on the blue floor of the nearer recess. Nevertheless, it would be a desolate land to be alone in with no such speck!

That same evening, in going southward, we steamed close in under the ice-cliffs of the Svea and Wahlenberg glaciers—contiguous neighbours, but at present of very

the peaks all day, but the valley was dry. Later, a flying visit was made to the whaling station by those who could face the ordeal; and in this manner was our programme for Ice Fiord brought to its appointed end. As our ship swung westward into the floes at the mouth of the fiord the evening sunlight glittered on the land, just as it had done at our approaching; so it chanced that our last view of Spitsbergen was like our first.

It had been planned that we should visit Hornsund next day in returning southward. But the ice-floes drove us westward even farther than before, and there would have been much risk in pushing landward through them again. Our journey to the lonely island was done. So, after a few hours of devious sailing, we emerged from the tangle into the open ocean, and there rolled uncomfortably southward under a cold thick sky for the next two days, gaining the welcome shelter of the Norwegian coast on the morning of August 12. It was on the previous night that we had reached into sunset again.

Being now a few hours ahead of time, our captain took us up the lovely Lyngen Fiord, in glorious weather, with a sprinkle of new snow on all the peaks. Thus were we reconciled to the loss of Hornsund. And at Tromsö in the afternoon we returned to the world of telegrams, letters and newspapers.

Of the after-voyage through the fiords to Trondhjem it is enough to say that the weather remained perfect; and that Dr. Hans Reusch, the Director of the Norwegian Survey, was of our company, so that we missed nothing that could be learnt in passing. At Trondhjem, moreover, on August 14, we had time, under Dr. Reusch's guidance, to visit the high strand-lines near the city and to examine the scientific and artistic collections in its museums, finishing the day with a pleasant reunion at one of the hotels. Here we left our ship, taking train on the morning of August 15 up the fine valley that leads across the Swedish frontier. We reached Åre in Jämtland in the afternoon, went eastward until evening across the ground we had seen from the summit of Areskutan, past the great Lake Storjon, and reached Stockholm, exactly on time, before breakfast on the morning of Wednesday, August 17. The initial reception of the members of the congress was held in Stockholm on the evening of that day.

To those who did not share in the pilgrimage this recital of our itinerary can at the best convey only a feeble idea of its advantages. Not the new country alone and the new experiences, but above all, the constant association and intercourse of men of different nationalities and outlooks, with interests in common which they were ever ready to discuss together—this it was that gave peculiar value to the journey, as to all journeys of the same type. Deeply indeed were we indebted to our leader, Prof. G. De Geer, and to the accomplished lady, his wife, for the whole-hearted enthusiasm which they threw into the difficult task of planning, guiding, and demonstrating in

Photo. by Oscar Halldin, Stockholm.] [*Reproduced by kind permission of Prof. G. de Geer.*

FIG. 3.—North end of Cora Island, Ekman Bay; showing the Sefström moraine of shelly clay, to the left of the inlet, and a portion of the original island to the right.

in time to make the ascent of Mt. Åreskutan (4620 feet) for the sake of the view from its summit over an immense range of lower lake-country to the eastward. The glacial phenomena of this region are like those of Torneträsk on a grander scale; the same evidence for a succession of glacier-dammed lakes, at first discharging westward over the watershed into Norway; the same shrinkage of the ice-sheet from the western mountain-rim to the lower eastern country; the same westward transport of the boulders. On the top of Åreskutan there are boulders which have come from places far away to the eastward at much lower altitudes.

In the evening Prof. C. Wiman joined us at Åre; and next morning, under his leadership, we visited sections near the Åre Lake, which show the fossiliferous Lower Palæozoic succession. We were able also to appreciate the evidence for a gigantic overthrust of the metamorphic rocks from the westward over the unaltered Palæozoics. Leaving Åre by train in the afternoon of August 16, we varied languages so that the time at our disposal should always be profitably spent; and even still more for the happy spirit of friendliness and geniality which they imparted to the whole expedition. Much also we owed to Mr. B. Högbom for his share in the direction of our party in Spitsbergen, and to Dr. Hj. Lundbohm, Prof. C. Wiman, and Dr. O. Sjögren for their aid in Sweden, while Mr. C. Carlzon and Mr. H. Ahlmann were our ever-obliging helpers and interpreters. In our admiration for the extraordinary skill with which every stage of the journey was arranged, we could not fail to recognise the thoughtful solicitude of our physician and treasurer, Dr. J. W. Nordenson, of whose high qualities as an organiser we had daily proof.

Brief must be our reference to the constitution of the party. The British geologists were lamentably few—G. A. J. Cole, A. P. Coleman, A. Strahan, and the writer—but, for the occasion, we will count with us also the U.S. Americans, R. S. Tarr, Miss F. Bascom, Miss Z. Baber, and Miss E. Rice. The German and Austrian

contingent was predominant, including (titles omitted) H. Credner, G. Gürich, K. Keilhack, A. Penck, A. Rothpletz, W. Salomon, K. Sapper, F. Wahnschaffe, and other well-known names. Among those from France were L. Carez, L. de Lamothe, E. de Margerie, and A. Offret; from Italy, S. Cerulli-Irelli and E. Mattirolo; from Portugal, J. Mendez-Guerreiro; from Switzerland, M. Allorge, J. Brunhes, and P. Mercanton. From Denmark, among others, came V. E. Hintze, V. Madsen, and J. P. J. Ravn; from Holland, J. I. J. M. Schmutzer and Mlle. A. Grutterink; from Norway, H. Reusch; from Hungary, E. de Cholnoky and E. de Maros; and Japan was represented by K. Inouye and H. Yabe. Broadcast now is the gathering that went with the good ship *Æolus* on this memorable voyage to Spitsbergen!

G. W. LAMPLUGH.

A FOURTH RECALESCENCE IN STEEL.

IN 1868 the late Dr. George Gore, F.R.S., discovered the recalescence points now known as Ar_3 and Ar_2, and in 1872 Prof. W. F. Barrett, F.R.S., discovered the point Ar_1, which is now known as the carbon change point. Prof. Barrett gave the phenomena the generic title of "recalescence," by which they have been known ever since.

Photo-micrograph of nearly Pure Iron containing 0·21 per cent. Carbon. Rapidly quenched between the two peaks of Ar_2. Magnified 450 diameters.

At the recent meeting of the British Association, Prof. J. O. Arnold described to the section of chemistry the result of accumulated thermal and micrographic observations upon this subject extending over twenty years. He first described the recalescence apparatus used at Sheffield University, in which the tape results can be plotted either as a time-temperature or as an inverse-rate curve. The latter is more delicate, its coordinates being units of temperature and time in seconds, for units rise or fall in temperature.

The Recalescence of Chemically Pure Iron.

From many observations it appears that before even a rough quantitative measurement of recalescence in steel can be made it is very desirable to obtain a standard cooling curve of iron absolutely free from carbon; this was made possible by a gift of chemically pure iron from Dr. Hicks and Prof. O'Shea, of Sheffield University. The recalescence data registered *in vacuo* on placing the thermocouple between two small plates of this iron show that the maximum of Ar_3 appears at 854° C., and the set-back between the two peaks of Ar_2 is registered at 750° C.

The Recalescence of Iron containing about 0·2 per cent. Carbon.

On cooling unsaturated steels containing about 0·2 per cent. carbon it was noticed that there was along the range of temperature between Ar_3 and Ar_1 some thermal evolution which prevented the curve crossing the radiation line after recalescence, and also kept it well to the right of that line. Careful investigation of this phenomena revealed the fact that whilst with iron containing 0·38 per cent. carbon this new and prolonged recalescence was very much augmented, as compared with a 0·2 per cent. carbon steel, that iron containing 0·63 per cent. carbon gives out during this fourth phase of recalescence much less heat than the 0·38 per cent. carbon steel. Therefore it would appear that the maximum of heat of the fourth phase of recalescence is evolved from a semi-saturated steel, namely, an iron containing 0·45 per cent. carbon, and having in the cold a micro-structure consisting of 50 per cent. ferrite and 50 per cent. pearlite. The recalescence data and curves of all these steels were shown on the screen and minutely described.

The Cause of the Fourth Phase of Recalescence.

By micro-thermal investigations Prof. Arnold has satisfied himself that the fourth phase of recalescence is due to constitutional segregation, namely, the falling out between Ar_3 and Ar_1 of the ferrite and hardenite from their state of mutual interpenetration or solid solution into microscopically invisible masses. A method was adopted for rapidly quenching from nitrogen in iced brine 0·2 per cent. carbon steel at various temperatures. The temperatures were:—(1) 995° C. (well above Ar_3); (2) just below Ar_3; (3) just after first peak of Ar_2; (4) just above Ar_1; (5) 15° (normalised or cooled in air).

The micrograph here reproduced is a section quenched between the two peaks of Ar_2. The segregation is obviously proceeding very quickly, and the ferrite is strongly electro-negative to the dark etching areas of hardenite still containing in solution large quantities of iron. The micrographs indicate that the critical range Ar_2 has no influence on the segregation of hardenite and ferrite. In Prof. Arnold's view these five photomicrographs, when correlated with the recalescence curves of the steel experimented upon, prove that the fourth phase of recalescence is due to the heat evolved during the segregation of the ultimate micrographic constituents of steel, which began at Ar_3 and incomplete at Ar_1, during the cooling of unsaturated steels at a moderate rate, say 0·5° per second.

REPORTS ON IMPERIAL FOODSTUFFS.

WE have received No. 63 ("Gums and Resins") and No. 71 ("Foodstuffs") of the "Colonial Reports: Miscellaneous," comprising selected reports from the Scientific and Technical Department of the Imperial Institute. They refer to products, from British possessions, examined at the institute with regard generally to the possibility of their profitable cultivation or preparation in the districts concerned. The first report is a useful little monograph on gums and resins from the commercial and analytical point of view, with particulars of the colonial specimens examined. The chief matter of scientific interest in the paper on foodstuffs, namely, a summary of the

facts relating to cyanogenesis in plants, has already been published elsewhere.

Among points of general interest we note that Yebb (or Yeheb) nuts from Somaliland, which grow in arid districts and have formed the principal food of many destitute refugees, were found to contain about 12 per cent. of albuminoids, 11 per cent. of oil, 24 per cent. of sugars, and 37 per cent. of other carbohydrates. They thus show high nutritive value as a foodstuff; and it is recommended that the cultivation of the plant (*Cordeauxia edulis*) producing the nuts should be tried in other countries, especially where a foodstuff is needed which can be grown in arid places. Tea from the Nyasaland Protectorate was found to be analytically of good quality, though on account of its having been packed with tobacco no opinion could be given on its flavour. Nevertheless, it is considered that the cultivation of tea in the Protectorate might well be extended. Some Natal tea, too, appears to be very satisfactory. Its proportion of caffeine is only slightly less than that of Indian tea examined, and as regards tannin it is intermediate between Indian and China teas. In the opinion of the department the cultivation and preparation of tea in Natal deserves very full study, with a view to the production of tea of characteristic quality.

Cocoa grown experimentally in Uganda gave very promising results. So also did some specimens cultivated by the Botanical Department of the Gold Coast Colony, though it was pointed out that more attention was required in the fermentation of the beans, since it is on this that the aroma and colour largely depend. Small consignments subsequently sent for actual sale realised fair prices, and from the knowledge gained it was possible to indicate the directions in which further improvement of the cocoa could be effected. Some useful memoranda on miscellaneous matters, such as the constituents of food and their functions, and the harvesting and shipment of maize, are also included in this report on foodstuffs.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The special board for medicine has elected Prof. Marsh, Master of Downing College, as its representative on the general board of studies for four years, and the special board for economics and politics has elected Mr. G. L. Dickinson as its representative on the same board for the same period.

Prof. Hughes states that he has received a very valuable gift of fossils, &c., from the widow of the Rev. G. F. Whidborne, who had previously presented to the Sedgwick Memorial Museum the collection of Devonian fossils which he had described in the Transactions of the Palæontographical Society. Mrs. Whidborne has now given to the museum the remainder of his collection, with all his scientific books and manuscripts, together with a valuable series of photographs and other illustrations, and has included in her gift the cabinets in which some of the specimens were kept and were being arranged.

The Vice-Chancellor publishes the following extract from the will of the late John Willis Clark, formerly Registrary of the University:—"I bequeath also to the Chancellor, Masters, and Scholars of the University of Cambridge my Collection of Voyages and Travels as recorded in a special catalogue, forming part of the collection, to be placed under the charge of the Museums and Lecture Rooms Syndicate. And I request the said Syndicate to deposit the same wherever in their judgment it is likely to be most useful."

The board of anthropological studies desires the establishment of a special examination in anthropology for the ordinary B.A. degree. The board reports as follows:—"As anthropology is a subject that is rapidly growing in importance, the board is of opinion that the time has arrived when it is desirable that a special examination in anthropology should be held. Anthropology is a science that demands extensive and precise study, and at the same time bears upon other branches of learning, for example, history, economics, psychology, biology, and geography. It may now be considered as a mental discipline not inferior to other subjects comprised in the various special examinations."

OXFORD.—On November 29 Congregation took into consideration some of the amendments that had been proposed to the statute concerning the faculties and boards of faculties, of which the preamble was approved on November 8. Exception had been taken in some quarters to certain provisions of the statute which appeared to disqualify the college tutors as such for membership of the faculties. An amendment proposed by the Master of Balliol providing that the head of any college or similar society within the University might certify any member of Convocation authorised by his society as a member of the faculty in which his teaching is given was carried without a division. Another amendment, proposed by the Master of University College, to the effect that a number of the members of the general board of the faculties should be elected from and by the whole body of members instead of from and by each faculty acting separately, was opposed by the President of Magdalen, Prof. Gotch, F.R.S., and Prof. Oman, and rejected on a division.

As was generally anticipated, the question of compulsory Greek is not to be allowed to rest in the position to which it was relegated by the division on November 22. A petition to council is being prepared, asking that a short statute may be framed relieving honour students in the schools of natural science and mathematics "from the necessity of taking two ancient languages in Responsions." This movement has the support, amongst others, of Sir W. Anson, Profs. Gilbert Murray, Myres, Poulton, F.R.S., H. H. Turner, F.R.S., and Osler, F.R.S., the latter of whom, however, has stated "that he is strongly in favour of retaining Greek in the case of candidates for the degrees in medicine."

MR. JAMES A. PATTEN, of Chicago, says *Science*, has given 40,000*l*. to endow a chair of experimental pathology in the medical school of Northwestern University. Special attention is to be directed to the study of tuberculosis and pneumonia. By the will of the late Mr. S. W. Bowne, bequests in stocks and bonds of considerable value are made to Wesleyan University and Dickinson College. Radcliffe College, we learn from the same source, has received from Mrs. Martha T. Fiske Collard a bequest amounting to about 20,000*l*.

M. MAURICE LERICHE has been appointed professor of geology at the University of Brussels. M. Leriche has been until recently "Maître de Conférences" at Lille University. He has recently issued an important monograph on the Oligocene fish of Belgium, published in the *Mémoires du Musée Royal d'Historie Naturelle de Belgique*, v. Prof. Dollo retains the chair of palæontology at Brussels University and conservator of the department of vertebrate remains of the Brussels Museum, and thus will continue in charge of the important collections which his work has rendered famous.

PRINCE ARTHUR OF CONNAUGHT has accepted the position of president of the appeal committee appointed to secure the sum of 70,000*l*. for the purchase of the site in Gower Place and for the erection thereon of new chemical laboratories for University College, London. We are glad to notice that the new president in a further appeal through the Press emphasises the national aspect of the appeal committee's object, and asks for a national response. As we have pointed out already, 25,000*l*. must be raised before December 25 next if the new site is to be secured, and towards this amount upwards of 10,000*l*. has been raised. It should not be difficult to secure the remaining 15,000*l*. during the next few weeks.

THE German Emperor opened a new technical university at Breslau on Tuesday, November 29, and delivered an address, in which he referred to the great importance of such institutions for the industrial progress of the Empire. There are now eleven technical universities in Germany, five of which are in Prussia, namely, at Charlottenburg, Aachen, Hanover, Danzig, and Breslau. The Berlin correspondent of the *Morning Post* reports that in the course of his remarks at the dedication of this—the second technical university founded in his reign—the German Emperor said:—"The close connection between

technical science and industry becomes year by year more manifest, and it is not by chance that the immense advance made by our industrial life is contemporaneous with the progressive development of the technical university system in Germany. The times are past in which a school of practice sufficed for the engineer. Whoever wishes to be equal to the demands made by technics in our time must go into the battle of life equipped with a solid scientific and technical education." His Majesty also remarked that Silesia had gained for itself an eminent position through the assiduity and spirit of enterprise which had enabled it to develop its coal and iron and its spinning and weaving industries, and he expressed the opinion that the inhabitants were perfectly justified in desiring to have a technical university in their capital. Dr. von Trott zu Solz, Prussian Minister of Ecclesiastical Affairs, addressing the Emperor, recalled the fact that it was King Frederick the Great who laid the foundation of the greatness of the Silesian industries, in that he encouraged the employment of Silesian coal in other industrial districts and overcame the prejudice against Silesian iron.

A CONFERENCE organised by the Joint Committee for the Abolition of Half-time Labour was held on November 23 at the Church House, Westminster, with the Bishop of Birmingham in the chair. The meeting was called to consider the question of the employment of children in mills and factories, and of securing the passage of a Bill through Parliament raising the age of "half-timers" to thirteen. Prof. Sadler, in a letter expressing inability to attend, said it is a drag upon the economic welfare of the country that more than 200,000 children between twelve and fourteen years of age have left the day school for good, and that more than 40,000 more only attend school half time. There is no reason in the nature of things why the number of boys and girls under fourteen who are wholly or partially exempt from day-school attendance should be proportionately six times as numerous in England and Wales as in Scotland. The chairman insisted that it is a ludicrous waste of energy and money to let education stop at the age of fourteen, thirteen, or twelve. The evil is increased by the system of half-time attendance. Two things, he said, are necessary to stop this wastage of education—to abolish the half-time system, except possibly in some very extreme and exceptional circumstances, and to press forward in the matter of continuation schools. If continuation schools are to be made a real force, the hours of work in shops must be restricted. It is physiologically certain that it is impossible to get real good out of education so long as the bodies and minds of children are in the main occupied in getting a living. Eventually the following resolution, which was proposed by Lord Sheffield, was carried:—"That this meeting approves of the recommendations of the Departmental Committee on partial exemption, and trusts that legislation, as promised by the Board of Education and unanimously approved by resolution by the House of Lords, may be carried into effect in the first session of the coming Parliament."

IN consequence of a suggestion of the Chancellor of the Exchequer made last March to a large deputation from English universities and colleges, a committee of representatives from these educational institutions was appointed to place before the Chancellor suggestions as to the principles of distribution on which, in its opinion, an additional grant to university Colleges might be utilised most effectively. The committee consisted of Mr. A. H. D. Acland, Sir Alfred Hopkinson, F.R.S., Sir Oliver Lodge, F.R.S., Sir Isambard Owen, and the Rev. Dr. A. C. Headlam. Conferences between the Chancellor of the Exchequer and the President of the Board of Education with the committee were held on November 16 and 17. The committee expressed the view that the Treasury Committee, on the advice of which grants are distributed, should take into consideration:—(1) Output.—That is, the extent and character of the work being done, including the number of students, the nature of the instruction given, and research and other work undertaken. (2) Needs in order to carry on the work efficiently: (*a*) staff, and the remuneration of its members: (*b*) accommodation and equipment. (3) Development.—The development of work which the several universities and colleges desire, and would be in a position to undertake effectively with further financial assistance, and having regard to provision already made from private benefactions, or other local support, or which may be obtained for such objects. The committee also pointed out it is essential for the universities and colleges to have freedom as to the mode of expenditure of grants to secure the greatest return from them and to meet constantly varying conditions. Great importance was attached to the grants being certain, and not liable to diminution, so long as the extent and character of the work are maintained. The Chancellor of the Exchequer expressed himself willing to grant an additional sum to the colleges to be allocated on the lines laid down by the committee, but subject to the condition that sufficient additional local support is forthcoming in each case, not only to maintain the existing activities of the college in conjunction with its existing Treasury grant and to place it on a secure footing in regard to its capital liabilities and requirements, but to meet a suitable proportion of the cost of maintenance of the new developments adopted. He was prepared to increase the total grant by 50,000*l.*, and promised (subject, of course, to compliance with the minimum conditions as to character, efficiency, &c., which any college is already required to fulfil in order to participate in the grant at all) not to reduce the existing grants to the several colleges.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, November 9.—Prof. W. W. Watts, F.R.S., president, in the chair.—L. **Richardson**: The Rhætic and contiguous deposits of west, mid, and part of east Somerset. This paper contains an account of the Rhætic strata of Somerset. The sections at Blue Anchor and Lilstock are described and correlated with those on the Glamorgan coast. The record by Prof. Boyd Dawkins of Rhætic mollusca in the top portion of the Grey Marls is confirmed, and their recognition as Rhætic is substantiated. The deposit between the top of the fossiliferous Grey Marls or "Sully beds" and the main bone-bed at Blue Anchor measures 22 feet, and teems with Rhætic fossils. The beds above the bone-bed agree well with those occupying the same stratigraphical position in Glamorgan. The now obscured sections, that were to be seen in the railway-cuttings at Langport and Charlton Mackrell, noticed by Mr. H. B. Woodward, are described. Huge boulder-like masses of rock were noted at the top of the Black Shales, and the White Lias proper, with a well-marked coral-bed, totalled 25 feet in thickness. The classic sections of Snake Lane, Dunball (Puriton), Sparkford Hill (Queen Camel), Shepton Mallet, and Milton (Wells), have been reinvestigated, and the thin Rhætic deposits in Vallis Vale, at Upper Vobster, and sections in the Radstock district, and on the Nempnett and neighbouring outliers, are described. This investigation has shown that the Microlestes Marls are equivalent to the Sully beds; that the Wedmore Stone occurs well below the bone-bed; that Moore's "flinty bed" at Beer Crowcombe is probably on the horizon of the Pleurophorus bed (No. 13); that the Upper Rhætic is as persistent as usual; that the White Lias proper is of restricted geographical extent: and that on the Bristol Channel littoral are marls, "Watchet beds," above the White Lias. Around Queen Camel, Moore's "insect and crustacean beds" appear to come in at a horizon which lies between the Watchet beds and the Ostrea Limestone. A classification of the Rhætic series is suggested. The fauna of the Rhætian is Swabian in facies, and the conclusion to be derived from the study of the beds is in agreement with Suess's view, that while the dominant movement was one of subsidence and not local but extended, it was, nevertheless, "oscillatory and slow."—Rev. G. J. **Lane**: Jurassic plants from the Marske quarry. The Marske quarry is situated on the northern side of the Upleatham outlier in the Cleveland district of Yorkshire. In the quarry several varieties of rock are

exposed, namely, shales, small coal-seams, sandstones, and a ferruginous bed. The beds are of Lower Oolite age, and belong to the Lower Estuarine series. From this quarry Dictyozamites was recorded for the first time in England. The writer has obtained nearly forty species from the quarry, among which are many characteristic Wealden plants.

Physical Society, November 11.—Prof. H. L. Callendar, F.R.S., president, in the chair.—Dr. C. **Chree**: The supposed propagation of equatorial magnetic disturbances with velocities of the order of 100 miles per second. The question of the simultaneity of magnetic disturbances recorded at different stations has recently been discussed by Dr. Bauer and Mr. Faris. A good many magnetic storms have so-called "sudden commencements." As regards these "sudden" changes, three things are conceivable: they may be absolutely simultaneous at different stations; there may be a very small difference of time corresponding to the rate of propagation of electromagnetic waves; or, finally, there may be, as Dr. Bauer concludes, longer intervals, amounting to several minutes, for stations remote from one another. Dr. Bauer concludes that Mr. Faris's figures demonstrate the truth of his theory that disturbances normally are propagated round the earth, sometimes eastwards, sometimes westward, the time of a complete revolution averaging about 3¾ minutes. The author of the present paper discusses the weaknesses of Dr. Bauer's theory. He points out that the theory could be adequately tested by a careful comparison of curves from selected stations fairly encircling the globe, choosing, if possible, stations the time-measurements of which are specially trustworthy.—Prof. W. B. **Morton**: Cusped waves of light and the theory of the rainbow. Diagrams were shown of the forms assumed by a plane wave of light falling on a spherical raindrop and twice reflected from the interior of the drop, as well as the waves emerging from the drop. The waves in general have cuspidal edges, which run along the caustic surfaces. This relation between the caustic and the cusps on the waves was pointed out by Wood in connection with the similar waves produced by reflection at a spherical surface. It had been noticed earlier by Potter, Jamin, and Macé de Lepinay. The phase over a wave of this type is not constant, the two portions on opposite sides of a cusp differing in general by a quarter period. Attention was directed to the advantage of regarding the distribution of light in the rainbow as the consequence of the interference of the cusped waves which run down to the observer's eye along the direction of minimum deviation. This way of looking at the matter is shown to be equivalent to Mascart's approximate method of explanation of the formation of the supernumerary bows by interference of disturbances coming from the two poles on the special wave-form used by Airy.

Zoological Society, November 15.—Dr. S. F. Harmer, F.R.S., vice-president, in the chair.—J. Lewis **Bonhote**: Experiments on the occurrence of the web-foot character in pigeons. After referring to Mr. R. Staples Browne's paper on the subject in the Proc. Zool. Soc. for 1905, in which the web-foot was shown to be a simple Mendelian recessive, Mr. Bonhote instanced further cases from the lofts of Mr. F. W. Smalley that bore out Mr. Staples Browne's conclusions. Both these gentlemen, however, gave the author birds from their strains, and in the first instance when webbed birds from the different strains were crossed an irregular result—namely, four normal and one webbed—was obtained. Matings from these birds were continued, and the results were, in almost every case, contrary to Mendelian expectations, normals throwing webs and webs throwing normals. After discussing various suggestions, Mr. Bonhote came to the conclusion that no really satisfactory explanation was forthcoming. The Mendelian inheritance was apparently there, but dominated and modified by some other agency.—E. **Degen**: Notes on the little known lizard *Lacerta jacksoni*, Blgr., with special reference to its cranial characters.—G. A. **Boulenger**: *Lacerta peloponnesiaca*, Bibr. A new description of this little known lizard, made from living specimens in the society's gardens, with the view of fixing its correct position in the genus Lacerta.—E. G. **Boulenger**: Remarks on two species of fishes of the genus Gobius, from observations made at Roscoff. The paper dealt with the specific distinction of *Gobius minutus* and *G. microps*.

Linnean Society, November 17.—Dr. D. H. Scott, F.R.S., president, in the chair.—Prof. G. **Henslow**: A theoretical origin of *Plantago maritima*, L., and *P. alpina*, L., from *P. Coronopus*, L. Vars. This suggestion arose from the presence of *P. maritima* around the erection of faggots for condensing the brine of the salt-spring of Bad Nauheim, which is some 240 miles from the nearest coast, for M. Lesage proved that fleshiness of maritime plants was the direct result of the presence of salt. *P. Coronopus* has many varieties, and all the characters upon which they are based are very variable; forms approximating the above species are already named.—Prof. G. **Henslow**: A theoretical origin of Monocotyledons from aquatic Dicotyledons through self-adaptation to an aquatic habit, being supplementary observations to a previous paper (Journ. Linn. Soc., Bot. xxix. [1892], p. 485). The conclusions arrived at are:—(1) Coincidences are innumerable in all parts of monocotyledonous plants with aquatic Dicotyledons. (2) Experimental verification now covers and explains a large proportion of these coincidences. (3) Terrestrial Monocotyledons retain by heredity many of the aquatic characters acquired by their ancestors when living a hydrophytic life, but they are now readapted to a life in air.

MELBOURNE.

Royal Society of Victoria, October.—Prof. E. W. Skeats in the chair.—T. S. **Hall**: The systematic position of the species of Squalodon and Zeuglodon described from Australia and New Zealand. *Squalodon wilkinsoni*, McCoy, *Zeuglodon harwoodi*, Sanger, *Kekenodon onamata*, Hector; and *Prosqualodon australis*, Lydekker, agree in having the molar roots fused, as distinct from the northern hemisphere forms. New genera based on the proportion of crown to fang are proposed, namely, *Parasqualodon* (*wilkinsoni*) and *Metasqualodon* (*harwoodi*).—C. M. **Maplestone**: Further descriptions of the Tertiary polyzoa of Victoria, part xi. A new family, Synapticellidæ, with n.g. Synapticella (6 spp.), is founded. The family is allied to Catenicellidæ and Eucratidæ, but the zoaria are free and rigid, and the zoœcia in single series. In all, 38 new species are described.—F. **Chapman**: A trilobite fauna of Upper Cambrian age (Olenus series) in N.E. Gippsland, Victoria. E. O. Thiele found a limestone near Mt. Wellington which he, Skeats, and Dunn hold to be interbedded in slates which on graptolite evidence are Upper Ordovician. The author records Agnostus, Crepicephalus, and Ptychoparia, besides brachiopods and a few other forms, all of which are held to show Cambrian affinities.—A. J. **Ewart**, Jean **White**, and Bertha **Wood**: Contributions to the flora of Australia, No. 16. The authors described a new grass, Sarga, n.g., from N.W. Australia, a new Linum from Tasmania, and others.

CAMBRIDGE.

Philosophical Society, November 14.—Prof. Wood in the chair.—Prof. **Biffen**: Some crosses with Rivet wheat. Cases of coupling of roughness of the chaff with grey colour were described from several crosses between subspecies of *Triticum sativum*, and also a case where two varieties normally immune to the attacks of *Claviceps purpurea* gave rise to an F_2 generation containing susceptible individuals.—Mrs. D. **Thoday** and D. **Thoday**: The inheritance of the yellow tinge in sweet-pea colouring. The yellow tinge in scarlet, salmon, and deep cream sweet peas is found to be very complex in character. In the deepest tinged flowers examined, Queen Alexandra and St. George, the yellow colouring is produced by at least three coincident recessive factors. The three are all independent of one another; two tinge the sap and affect the whole flower, while the third is a plastid character, especially affecting the standard and pro-

ducing marked bicoloured forms. In the absence of yellow plastids the flowers do not "burn," unlike most known salmon or scarlet varieties.—Dr. R. N. **Salaman**: Demonstration of Mendelian laws of heredity in the potato.—Prof. **Wood**: The feeding value of mangels. Reference was made to a former communication on the composition of the five types of mangels. The present paper describes a series of feeding trials designed to ascertain if the percentage of dry matter is a fair index of feeding value. Nine experiments are discussed, and the result arrived at is that the percentage of dry matter does indicate the feeding value.—F. H. A. **Marshall**: Some causes of sterility in cattle. Sterility in some cases was shown to be probably due to a deposition of lipochrome in the ovarian interstitial tissue, associated with follicular degeneration.—F. H. A. **Marshall** and K. J. J. **Mackenzie**: Caponising. It was shown that in a case of incomplete caponisation, where pieces of testis of varying sizes had become transplanted on to the intestine and in other abnormal positions, spermatozoa were formed in the testicular grafts in spite of the fact that they were virtually ductless glands; also that the development of the secondary male characters and sexual desire were almost normal, as in the cases described by Foges and Shattock and Seligmann.—F. W. **Foreman**: Notes on protein hydrolysis. During the hydrolysis of the protein of Linseed the following points worthy of special mention were noted:—(1) By a modification of the ordinary method it was found possible to separate practically the whole of the glutaminic acid as the hydrochloride in the early stages of the hydrolysis. (2) The very high content of valin compared with leucin. (3) The low percentage of tyrosin. (4) The discovery of a basic lead salt of tyrosin, and the possibility of introducing a trustworthy method for the estimation of tyrosin in a mixture of amino-acids obtained from a protein by hydrolysis by precipitating it as this basic lead salt.—K. R. **Lewin**: Nuclear relations of *Paramecium caudatum* during the asexual period. The micronucleus of *Paramecium caudatum* is not necessary to continued multiplication by fission. By merotomy an amicronucleate race was obtained which maintained itself for seven weeks. This result was not due to fusion of mega- and micronuclei under the stimulus of operation.

DUBLIN.

Royal Dublin Society, November 22.—Prof. T. Johnson in the chair.—Prof. W. **Brown**: Mechanical stress and magnetisation of nickel. The author gave the results of experiments on magnetism and torsion of nickel wires when the wires were of different degrees of magnetic softness and of different lengths and diameters, which show several peculiarities in the behaviour of nickel as compared with iron when tested under the same conditions.—Prof. T. **Johnson**: A seed-bearing Irish pteridosperm—*Lyginodendron Oldhamium*, Willm. The author records the presence in Ireland of the Pteridospermeæ, and gives an account of specimens of *Sphenopteris Hoeninghausi*, Brgt., in the botanical division of the National Museum, Dublin, and especially of one specimen of this in the Geological Survey collection. This specimen shows not not only the connection of *S. Hoeninghausi* with the stem of Lyginodendron, but also the direct continuity of the fossil known as *Calymmatotheca Stangeri* with *Lyginodendron rachis*. In addition the author describes the presence of a Lagenostoma seed in one of the cupular rosettes of Calymmatotheca. The specimen furnishes the evidence of direct continuity in support of the views of Oliver and Scott on the synthetic reconstruction of the Palæozoic pteridosperm *Lyginodendron Oldhamium*.

PARIS.

Academy of Sciences, November 21.—M. Émile Picard in the chair.—M. Francotte was elected a correspondant in the section of anatomy and zoology in the place of the late M. Van Beneden.—J. **Guillaume**: Observations of Cerulli's comet made at the Observatory of Lyons. Data are given for November 12 and 16. The comet is of about the tenth magnitude; a small tail was visible on November 16th.—M. **Luizet**, J. **Guillaume**, and J. **Merlin**: Occultations observed during the total eclipse of the moon of November 16, 1910, at the Observatory of Lyons.—L. **Montangerand**: Observation of the total eclipse of the moon of November 16, 1910, made at the Observatory of Toulouse.—M. **Lebeuf**: The total eclipse of the moon of November 16, 1910, observed at the Observatory of Besançon by MM. Chofardet and Goudey.—M. **Bourget**: Observations of the total eclipse of the moon of November 16, 1910, made at the Observatory of Marseilles.—Robert **Jonckheere**: The total eclipse of the moon of November 16–17, 1910, at the Obervatory of Hem.—E. **Cartan**: Isotropes capable of development and the method of the mobile trihedron. Eugène **Fabry**: Order of the singular points of a Taylor's series.—A. **Chatelet**: The theory of numbers.—T. **Lalesco**: Resolving nuclei.—Marcel **Brillouin**: The discontinuous movement of Helmholtz. Curved obstacles.—M. **Villat**: The resistance of fluids limited by a fixed indefinite wall.—MM. **Claude**, **Ferrié**, and **Driencourt**: Telephonic and radio-telegraphic comparisons of chronometers by the method of coincidences between Paris and Brest. The difference between the two sets of comparisons by telephone and by wireless telegraphy is less than 0·01 sec.; if necessary, the accuracy could be increased.—G. A. **Hemsalech**: The modifications undergone by the lines of the spark spectrum in a magnetic field. A development of work described in a previous paper. Three classes of phenomena are shown to exist: a general effect independent of the direction of the lines of force of the magnetic field; a longitudinal effect, produced when a spark is parallel to the lines of force; and a transversal effect, produced only with very slow discharges, when the spark is perpendicular to the lines of force. In the present paper observations on the first two of these effects are described and discussed.—G. A. **Andrault**: A rapid graphical method for measuring the slipping of induction motors.—Francisque **Grenet**: Study of the porosity of Chamberland filters. The dry filter, placed vertically, is completely filled with mercury, and a fine steel tube passed through a close-fitting stopper is connected with a calibrated glass capillary tube. On plunging the filter into distilled water, the air in the capillaries of the porous pot is driven inwards, causing a rise of the mercury in the glass capillary. Filter tubes of different makes showed large differences in the pressures thus measured, varying from 18 cm. to 2 metres of mercury. These pressures measure the diameters of the pores of the filter.—J. **de Kowalski** and J. **de Dzierzbicki**: The progressive phosphorescent spectrum of organic compounds at low temperatures. Figures are given for the bands of benzene and nine of its homologues, for phenol, cresols, and xylenols and benzyl alcohol. The results show that progressive phosphorescence is a property which depends essentially on the constitution.—Charles **Moureu** and J. Ch. **Bongrand**: Propiolic compounds. Cyanacetylene. Methyl propiolate, $CH{:}C.CO_2CH_3$, was converted into propiolamide, $CH{:}C.CO.(NH_2)$. By the action of phosphorus pentoxide upon this amide, cyanacetylene, $HC{:}C—CN$, is obtained. This forms a mobile liquid boiling at 42·5° C., solidifying in ice to a mass of crystals melting at 5° C. The physical and chemical properties of this compound are given in detail.—Casimir **Cépède**: An improvement of the binocular microscope, increasing the illumination of the objects under observation.—Marcel **Mirande**: The effects of tarred roads on vegetation. It has been found experimentally that the vapours given off by tar such as is used for treating roads act injuriously on green plants. In the open country the vapours given off by a tarred road would be insufficient to damage vegetation, but in shut-in streets damage to trees planted on the edge of the pavement may be expected.—Jules **Amar**: Respiratory exchanges after work has been done. The amount of oxygen used by a human subject was measured, first, when at rest, then during work, and finally at regular intervals after cessation of the work. The original consumption of oxygen was reached in from six to eight minutes after the work was stopped. The rate of decrease of oxygen absorption varied with each subject.—Ch. **Gravier**: The battle for existence in the

madrepores of coral reefs. The forms which succumb in the struggle are those which are large and globular; the arborescent forms have more resisting power.—E. **Roubaud**: The evolution and history of *Roubandia rufescens*, a parasite of the social African wasps, genera Icaria and Belonogaster.—P. **Fabre-Domergue** and R. **Legendre**: The search for *Bacterium coli* in sea water by the methods employed for fresh water. All the usual tests for coli in fresh water are retarded in their action by the presence of common salt. Certain modifications of technique necessitated by this fact are suggested. The question has arisen in connection with the control of oyster beds.—J. **Couyat** and P. H. **Fritel**: The presence of plant impressions in the Nubian grit in the neighbourhood of Assouan.

CAPE TOWN.

Royal Society of South Africa, October 19.—Mr. S. S. Hough, F.R.S., president, in the chair.—A. G. **Howard**: An investigation into the land and sea breezes conditions at Port Elizabeth. A second contribution to the meteorology of South Africa.—E. T. **Littlewood**: Graphical representation of some of the simpler analytic functions of a complex variable. The modulus of the function corresponding to each point of the (horizontal) xy plane was represented by the length of a vertical line erected at that point, the upper extremities of these lines forming a ("modular") surface, while the argument was represented by a family of curves ("stream lines") drawn in the xy plane. Certain general results were established and methods given. In the models, the surface was suggested by a wire framework, which usually illustrated contour lines and vertical sections, while the stream lines, drawn on the horizontal base of the model, were visible through the framework. The simpler algebraic, circular, exponential, and logarithmic functions were thus treated.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 1.

LINNEAN SOCIETY, at 8.—Spermatogonesis in Stenobothrus: Capt. C. F. U. Meek.—Reports on the International Botanical Congress at Brussels, 1910: Dr. Otto Stapf and others.

RÖNTGEN SOCIETY, at 8.15.—Osmotic Growths: Dr. Deane Butcher.

FRIDAY, DECEMBER 2.

GEOLOGISTS' ASSOCIATION, at 8.—The Geology of Natal: Dr. F. H. Hatch.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Scherzer Rolling-lift Bridge over the River Tawe, at Swansea: J. H. Morris.

MONDAY, DECEMBER 5.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Geographical Aspects of the Problem of Empire Cotton Growing: J. Howard Reed.

ROYAL SOCIETY OF ARTS, at 8.—Industrial Pyrometry: C. R. Darling.

ARISTOTELIAN SOCIETY, at 8.—A Defect in the Current Logical Formulation of the Basis of Induction: Bernard Bosanquet.

VICTORIA INSTITUTE, at 4.30.—The Theory of Jurisprudence: Judge G. H. Smith.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Analytical Constants of Shellac, Lac-resin and Lac-wax: Puran Singh.—Theory of Dyeing: Resolution after Treatment with Acids, &c.: W. P. Dreaper and A. Wilson.—Some Indian Oils and Fats: A. Kesava Menon.

TUESDAY, DECEMBER 6.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: Portland Cement, and the Question of its Aeration: H. K. G. Bamber.

WEDNESDAY, DECEMBER 7.

ROYAL SOCIETY OF ARTS, at 8.—The Panama Canal in 1910: Dr. Vaughan Cornish.

SOCIETY OF PUBLIC ANALYSTS, at 8.—On Fischer's Modification of Volhard's Method for the Estimation of Manganese, and its Comparison with other well known Methods: E. Cahen and H. F. V. Little.—Note on the Composition of British Wines: E. Russell and T. R. Hodgson.—A New Volumetric Process for the Estimation of Tungsten: Dr. E. Knecht and E. Hibbert.—A New Volumetric Process for the Estimation of Molybdenum: Dr. E. Knecht and F. W. Atack.—The Degree of Accuracy with which the Proteins of Milk can be Estimated by the Aldehyde Method: H. D. Richmond.—Note on Gorgonzola Cheese: E. Hinks.—Tests for Cocaine and certain Cocaine Substitutes: Dr. E. H. Hankin.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, DECEMBER 8.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Colour-blindness and the Trichromatic Theory. Part II. Incomplete Red or Green Blindness: Sir W. de W. Abney, K.C.B., F.R.S.—On the Sensibility of the Eye to Variations of Wave-length in the Yellow Region of the Spectrum: Lord Rayleigh, O.M., F.R.S.—(1) Trypanosome Diseases of Domestic Animals in Uganda. IV. *Trypanosoma uniforme*, sp. nov.; (2) Trypanosome Diseases of Domestic Animals in Uganda. V. *Trypanosoma nanum.* (Laveran): Colonel Sir D. Bruce, C.B., F.R.S., and others.—Some Enumerative Studies on Malarial Fever: Major R. Ross, C.B., F.R.S., and D. Thomson.—On Hæmoglobin Metabolism in Malarial Fever: G. C. E. Simpson.—A Case of Sleeping Sickness studied by precise Enumerative Methods. Further Observations: Major R. Ross, C.B., F.R.S., and D. Thomson.—Enumerative Studies on *Trypanosoma gambiense* and *Trypanosoma rhodiense* in Rats, Guinea-pigs, and Rabbits; Periodic Variations disclosed: Dr. H. B. Fantham and J. G. Thomson.—The Life History of *Trypanosoma gambiense* and *Trypanosoma rhodiense* as seen in Rats and Guinea-pigs: Dr. H. B. Fantham.—Experiments on the Treatment of Animals infected with Trypanosomes, by means of Atoxyl, Vaccines, Cold, X-rays, and Leucocytic Extract; Enumerative Methods employed: Major R. Ross, C.B., F.R.S., and J. G. Thomson.

MATHEMATICAL SOCIETY, at 5.30.—(1) Properties of Logarithmico-exponential Functions; (2) Some Results concerning the Increase of Functions defined by an Algebraic Differential Equation of the First Degree: G. H. Hardy.—Optical Geometry of Motion: A. A. Robb.—(1) Note on the Pellian Equation; (2) A Property of the Number 7: T. C. Lewis.—On the Arithmetical Theory of Binary Cubic Forms: G. B. Mathews.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Magnetic Properties of Iron and its Alloys in Intense Fields: Sir R. Hadfield, F.R.S., and Prof. B. Hopkinson, F.R.S.

FRIDAY, DECEMBER 9.

ROYAL ASTRONOMICAL SOCIETY, at 5.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Recent Progress in Electric Lighting: Prof. E. W. Marchant.

CONTENTS. PAGE

THURSDAY, DECEMBER 8, 1910.

FRESH-WATER FISH-CULTURE IN FRANCE.

Encyclopédie agricole. Pisciculture. By Georges Guénaux. Introduction by Dr. P. Regnard. Preface by M. Charles Deloncle. Pp. xii+489. (Paris: Baillière et Fils.) Price 5 francs.

THIS is a comprehensive, compact, and eminently practical handbook on all matters relating to fresh-water pisciculture. Much of the information and criticism which it contains applies almost equally to England as to France, since most of the fishes dealt with are found in our islands, and the almost complete neglect of fresh-water pisciculture—except in the case of the Salmonidæ—is as characteristic of this country as of that. What is true of the depopulation of the French watercourses is partly true of our own. In France the depopulation and its neglect were due partly to obvious causes inseparable from industrial progress, such as the opening of canals, the development of navigation, and the establishment of manufacturing works and chemical factories on the river banks, and partly to lack of enthusiasm following on historical events. The means adopted to arrest the depopulation, much less to restock the waters, have been, and continue to be, utterly disproportionate to the extent of the waters and to the magnitude of the task.

The results of this neglect are:—(1) That France consumes extremely little fresh-water fish, either absolutely, or relatively to the consumption of marine species; and (2) that the great bulk of what little she does consume is derived from adjacent countries, principally Germany, where the rearing of carp especially has been developed into a paying industry by long years of experience and the application of scientific methods. While it is possible, as hinted by the author, that a protective tariff might do a little to obviate this unsatisfactory state of affairs, the only complete solution of the problem is for France to grow her own fish. These French watercourses (our own rivers and broads also to some extent) are capable of producing an abundance of highly nutritious food. In both countries there are numerous fresh-water species the *chaire* of which, M. Guénaux assures us, is *excellente,* and would form a pleasing variant to the marine species which at present more or less flood the fish markets and almost exclusively appear on our tables. Clearly something should be done to develop this branch of food production, and to some extent M. Guénaux's practical text-book points the way.

But although fresh-water fish-culture is in the main neglected in France, there are a few salmon- and trout-hatching establishments, which seem to cost very little and pay remarkably well; also several laboratories connected with schools of agriculture, which contribute to the repopulation of the waters. Finally, attached to the Universities of Grenoble, Clermont-Ferrand, Toulouse, and Dijon are scientific laboratories for the study of fresh-water biology which pursue a double aim, scientific and practical. The University of Toulouse in particular has a large institution, started in 1903, devoted entirely to fresh-water pisciculture and hydrobiology, with museums, aquarium, and laboratories. In this matter England has something to learn from France, since, to the best of the reviewer's knowledge, the only station devoted to fresh-water hydrobiology in this country is a small private one on a Norfolk broad.

In writing a book on the whole subject it has been necessary for its author to combine the knowledge and qualities of a naturalist with those of an engineer and "practical man." This unusual demand on one's capacity and versatility has been met by M. Guénaux with conspicuous success. A critical inspection of the text of this book shows that its author is almost equally familiar with the morphological characteristics, taxonomic relations, and bionomical reactions (including feeding and spawning habits and requirements) of each species of fresh-water fish as he is with the merits and demerits of different kinds of salmon ladders, or the latest devices connected with egg-hatching apparatus, while he is evidently thoroughly *au fait* with the French laws relating to fresh-water fisheries, the weaknesses of which legislation he criticises in a characteristically practical manner.

The book opens with a brief account of the general anatomy of fishes, proceeding to take up each group in its natural order, explaining their taxonomic relations, and then giving a concise description (with good figures) of the distinguishing features and natural history of all the principal species, the most important features, namely, the feeding and spawning peculiarities of each, receiving particular attention. Then follows the subject of pisciculture proper, which forms the bulk of the volume. There are two kinds of pisciculture—natural and artificial. The object of natural pisciculture is to multiply the more valuable species by favouring their conditions of existence. Under this heading come such matters as the effects of navigation, canal-making, and industrial works, and the methods of combating these effects, and of restoring natural conditions, the planting of canals and dykes with plants on which the useful species may deposit their eggs, or seek shelter, the erection of ladders, and the construction of ponds, &c. By "artificial pisciculture," on the other hand, is meant the artificial fertilisation and hatching of the ova and the subsequent rearing of the fry. With the principal technical details of both kinds of pisciculture M. Guénaux deals exhaustively in a methodical and discriminating manner. As has been said, this is a thoroughly practical handbook, abounding in figures from statistics, measurements, and the critical comments of one who has had much first-hand experience of every branch of the business. There are plenty of good wood-cuts to illustrate construction of apparatus, &c. A succinct but fairly comprehensive account of aquatic invertebrate fauna and the flora next follows, and there is, finally, an excellent section on the parasitic diseases of fresh-water fishes and of injurious insects, reptiles, birds, and mammals. These chapters are also amply illustrated.

But even M. Guénaux's knowledge and versatility

have their limitations, and when he passes from fresh to salt water (metaphorically speaking) he appears somewhat "out of his element." Otherwise he would not have quoted antiquated and rejected notions regarding the growth of salmon after its migration to the sea in the face of the well-ascertained results of a vast amount of more recent research. Again, the author's account of the life-history of the eel is not abreast of current knowledge, since he makes no mention of the most important and not so very recent discovery of the breeding-grounds of this species all along the eastern shelf of the Atlantic basin. Reading M. Guénaux's account, one would suppose that the latest word on the subject of the eel had been said by Signors Grassi and Calandruccio, which is not so.

Then, again, the fear (casually expressed, it is true) lest certain species of pelagic sea fishes, such as the pilchards (sardines) off the west coast of France, be in danger of extermination through over-fishing is probably unwarranted, and argues a lack of knowledge of the conditions of life in the sea. Finally, returning to the salmon, it will surely surprise anyone who has some knowledge of the Highlands of Scotland and of the rigorous restrictions to which salmon-fishing is subjected in this region at the present day, to be told that:—

"*Aujourd'hui,* c'est dans ce pays [viz., Scotland] que les domestiques sont obligés de stipules à l'avance que le saumon no paraîtra trop fréquemment dans leur ordinaire!"

These happy days are almost ancient history. But such matters are, after all, quite on the fringe of M. Guénaux's subject. Enough has been said to indicate that the book is a small mine of information, and should be consulted by all whose business or pleasure brings them face to face with any of the difficult problems connected with fresh-water pisciculture.

WILLIAM WALLACE.

A CYCLOPÆDIA OF AGRICULTURAL CHEMISTRY.

Kleines Handwörterbuch der Agrikulturchemie. By Dr. Max Passon. Two vols. Erster Teil, Aadl-kynurensäure. Pp. iv+454. Zweiter Teil, Lab-zymogen. Pp. 415. (Leipzig: Verlag von Wilhelm Engelmann, 1910.) Price 22 marks.

THESE two volumes bear striking testimony to the enormous strides made during the last twenty years in agricultural chemistry. Only within very recent times has the need for a cyclopædia been felt; previously the chemist could always pull through if he possessed one of the larger analytical treatises and had access to a set of the *Jahresberichte* for agricultural chemistry. Rapid progress set in when the subject was emancipated from the analytical stage; when the chemist, instead of being confronted with an interminable succession of analyses of manures, feeding-stuffs, and soils, was free to study the numerous problems presented by the plant in its relation to the soil, on the one hand, and the animal on the other.

To the popular mind the agricultural chemist is still an analyst, and beyond doubt the analyst is more necessary than ever he was; but the distinction between the two is fast becoming as sharp as in pure chemistry. This process of segregation is going even further, and already men are specialising in the various branches of agricultural chemistry itself. Hence the need of reference books like the present volumes.

One of the features of the book is the treatment of laboratory operations. The ordinary methods are dealt with in some detail, there are numerous illustrations, and, where necessary, tables of figures. Even such minor but important processes as the recovery of platinum, silver, &c., from their residues find a place. In addition, a number of tests are given, and methods for finding whether nitrogen is present as an amide group, an amino-acid, or an ammonium salt. Although these are probably the fullest articles in the volumes they are rather restricted in their scope, attention is devoted almost exclusively to German methods, little space being given to those in use elsewhere. In several instances the book suffers in consequence. Thus we find the methods for the mechanical analysis of soils are very incomplete; the separations are carried only far enough to include material more than 0·2 mm. in diameter, all below this limit being grouped together as fine sand, &c. This is very unfortunate, because it is now known that the finer fractions—those falling between 0·2 and 0·04 mm., between 0·04 and 0·01 mm., between 0·01 and 0·002 mm., and below 0·002 mm.—really play a controlling part in soil fertility; indeed, no soil analysis can be fully interpreted without knowing them.

The book is, however, more than a laboratory manual, and space is found for some of the great generalisations and theories that have played a part in the development of the subject. The treatment is all too brief, especially when one remembers the importance rightly attached in Germany to theoretical considerations. Liebig's famous "law of the minimum" is stated, but its modern developments are not mentioned. "The growth of the plant is governed by the quantity in the soil of that food constituent which is present in the smallest amount." This generalisation has proved of great value in agriculture, but it is now merged in the wider conception of limiting factors, which we should like to have seen discussed in the book. It is now recognised that certain requirements must be fulfilled before plants will grow well—there must be ample water, air, warmth, food, light, and no injurious substance must be present. Any increase in one of these factors may lead to an increased crop production, but the increase is soon limited by the insufficiency of some one or more of the other necessary factors. If all are increased, the limit is finally set by the plant itself. In general, however, modern hypotheses are not given; we have been unable to find any mention of the well-known toxin-excretion theory of Whitney, which supposes that infertility arises through the excretion of toxic substances by plant roots. Whether it ultimately turns out correct or not, this theory has led to so much investigation that it deserved a place.

A critic could easily point out much more that has been omitted. But he would find it difficult to see how it could be otherwise within the limits of two

volumes, the available space of which has been still further reduced by the numerous good illustrations the editor gives us. There are, however, cases where the really important information is not given. Take, for instance, the note on *Molinia coerulea*. We are told that it has the power of absorbing considerable quantities of the salts of heavy metals, and a case is quoted where the ash contained 2·041 per cent. of lead oxide, 0·266 per cent. of copper oxide, and 0·265 per cent. of zinc oxide; further, we are told that it is regarded as a bad pasture grass. Now molinia is a weed and not a cultivated crop, and the things the chemist wants to know about it are these: What soil conditions does the presence of molinia indicate? and has molinia ever been observed to produce any ill-effect on animals? if so, what is the harmful constituent? Information could have been given on the first point that would have been valuable, for molinia is a useful "indicator" plant. Again, we are given analyses of animal excreta, but no mention is made of the fact that the composition is very variable, nor are we told whether the figures represent means of many analyses or only one or two determinations.

A more serious defect, however, is the omission of references. The student is rarely told where to go for fuller information, and it is practically impossible for him to check the data given in the article unless he knows his way about the literature of the subject. It is inevitable that dictionary notes should be short and should omit much; their great value ought to be the guidance they afford to the man who wants to learn more. But even with this defect the volumes are very useful, and will prove a distinct acquisition to the agricultural chemist.

E. J. RUSSELL.

RADIO-CHEMISTRY.

Radiochemistry. By A. T. Cameron. Pp. viii + 174. (London: J. M. Dent and Sons, Ltd., 1910.) Price 2*s*. 6*d*. net.

THIS book purports to be an "exact account of our present knowledge of the chemical properties of the radioactive substances and their chemical effects," and in the preface much stress is laid on the "accuracy" of the facts and theories here presented. It is further stated that the subject is "treated from a chemical standpoint," while "the physical side is introduced only so far as is necessary to explain the special experimental methods." As to how well the author has attained the latter object can be best judged from two examples, one a description (quite incorrectly asserted to be "that in Rutherford's 'Radioactivity,' p. 86") of a Wilson type of electroscope (p. 10), where, in addition to a very extraordinary earth connection, the movement of the aluminium leaf is observed by a "telescope" which "carries a scale," a distinctly inconvenient and unusual arrangement; and the other a description of a Dolszalek electrometer (p. 13) having "one pair of quadrants connected to earth, the other to an insulated metallic plate facing a second which carries the radioactive matter to be tested." "Through action similar to that in the case of an electroscope an electric stress is set up between the two pairs," and "the needle, previously charged to a very high potential, is repelled from one pair of electrodes towards the other"!

The chapter on the "Classification of the Radioactive Elements—their Physical and Chemical Properties" might be expected to justify the title chosen for the book, but it is disappointing to an extreme extent; the chemical properties of uranium, for example, being dismissed with the bare statement that "it belongs to the iron group of elements and is precipitated by ammonium carbonate." The discussion of the identification of ionium is quite misleading, and the account of the chemical properties of the other radio-elements of a very superficial character. The statement that thorium "occurs chiefly in Ceylon" is certainly surprising. It is doubtful whether anyone not already somewhat familiar with the subject could separate or identify a single radio-element from the directions which are given.

Errors and misleading statements are not uncommon. Thus (p. 17) the simple exponential equation $I_t = I_0 e^{-\lambda t}$ is given in an inverted and incorrect form, which again appears later (p. 90). Further examples are the statements (pp. 56, 141) that radiothorium "is precipitated with barium," "resembles radium in every respect," and has an activity "several hundred thousand times that of radium"; that in the separation of uranium X by treatment with a mixture of ether and water (p. 39) "the ether layer contains most of the photographic or β-ray activity"; that the active deposit from the radium emanation (p. 51) "decays to half value in twenty-eight minutes, but the decay curve is very irregular"; and that "the actinium products have all extremely short lives so that the maximum activity is quickly reached (p. 56). The mention of the "decay curve of a *radioactive child*" (p. 17) certainly suggests the most gruesome possibilities!

B. B. BOLTWOOD.

EGYPTOLOGICAL RESEARCHES.

Egyptological Researches. By W. Max Müller. Vol. ii., Results of a Journey in 1909. Pp. v + 188 + 47 plates. (Washington: Carnegie Institution, 1910.)

FOUR years ago Herr W. M. Müller, now of Philadelphia, published a first volume of "Egyptological Researches," brought out at the expense of the Carnegie Institution of Washington, which had borne the expense of the journey to Egypt in 1904 the results of which were thus published by Herr Müller. In 1906 Herr Müller undertook a second journey to Egypt, and now publishes a second volume of these "Researches."

Herr Müller's chief aim on both journeys was to pick up as much as possible of the hitherto unedited and badly edited historical material which still is to be found in the inscriptions of Thebes, notwithstanding the labours of many Egyptologists. In his first volume he published in colour the extant remains of the famous pictures of Minoan Cretan ambassadors in the tomb of Senmut, the prime minister of Queen Hatshepsut, which are so important to the Greek archæologists. These pictures had already been pub-

lished long ago, in colour, by the French scholar Prisse d'Avennes. The tomb was then lost sight of until re-discovered by Prof. Newberry some years ago. No new publication of the tomb was made, though it is understood that Mr. Howard Carter made a fine coloured drawing for one, until Mr. H. R. Hall published some rough sketches, correcting Prisse's errors, in the "Annual of the British School at Athens" (vol. viii., pp. 172–3), following this up with a photograph of the whole important scene, in the same publication (vol. x., p. 154). Herr Müller then followed with a coloured reproduction on a larger scale in the first volume of "Egyptological Researches." This is very useful, though naturally it is not likely to be so good as Mr. Carter's drawing, which so unaccountably remains unpublished still. Herr Müller's colours were too crude.

In the present volume of "Researches," Herr Müller provides us with similar (and too crudely) coloured reproductions of the scenes painted on the walls of the tomb of Menkheperrā-senb, which also include representations of Minoans. The figures and features of the Cretan ambassadors to the court of Thothmes III. are here represented more clearly than in the tomb of Senmut, though the vases which they carry are not so well or so carefully portrayed. The best of all these representations is probably that in the tomb of Puamra, also at Thebes, which will, we hope, shortly be published with a coloured drawing made on the spot by a most competent artist, Mr. de Garis Davies.

Herr Müller publishes a great many other scenes from tombs and temples at Thebes, with explanations, which are naturally comprehensible only to Egyptological experts, though the subjects of which they treat are of great interest to the general historian, anthropologist, and archæologist. Herr Müller is too technical, is insufficiently explicit, and assumes too much knowledge on the part of his readers, since he is not now writing exclusively for the edification of his *engeren Fachgenossen*. His style also is too notebooky, too much mere jotting down, too *staccato*, though we must congratulate him on his command of English. It is true that he would have done well had he submitted his text for revision to an American colleague before publication, as there remain in it many clumsy phrases and strong Teutonisms. Such forms as "Merenptahtext," "Kahunpapyrus," are German, not English; we always insert a hyphen between the elements of such combinations. We may also quote a very weird phrase on p. 76, "not doest thou look at the mountains" for "thou dost not look at the mountains"; and the quaintly unintelligible sentence, "strange that Duemichen's uncritical credulity toward the plays of the latest time has been revived recently!" (p. 39), needs an Egyptologist with a knowledge of German as interpreter. Herr Müller is not talking about *Schauspiele*, as one might suppose. It is not clear to us what, or rather whom, he is here talking about, or rather, at; this writer seems somewhat given to cryptic "digs" at other men of science, which are apt to fall flat if incomprehensibly phrased!

Though the coloured plates might sometimes be more carefully printed (*e.g.* plate xii. in our copy), the photographic illustrations of the battle-scenes of Rameses II. at Karnak and Luxor are very fine, and the whole book reflects credit on its author and great credit on the Carnegie Institution.

UNPROGRESSIVE PETROLOGY.

Les Roches et leurs Éléments minéralogiques; Descriptions, Analyses Microscopiques, Structures, Gisements. By Ed. Jannettaz. Fourth edition, revised and enlarged. Pp. 704. (Paris: A. Hermann et Fils, 1910.) Price 8 francs.

MOST of those who were students of petrology in the later years of the nineteenth century were familiar with a modest volume, published by the late M. Jannettaz, under the title of "Les Roches." It had a special interest for English readers, as it enabled them to realise the lines on which the teaching of the subject was carried on in France. Amongst other matters, it comprised a readable account of the Haüy system of crystal notation long forgotten in this country, a short section on crystal optics, and a description of the chief rock-forming minerals and rock types.

It was considerably enlarged but hardly improved in the third edition published, after a long interval, in 1900, and still to be found in some of our reference libraries. More than a hundred pages are devoted to the optical characters of crystals, but the treatment is at once ambitious and incomplete, and whatever merits it possesses are obscured by the innumerable misprints and blunders, which are found in its pages, and must render them almost unintelligible to anyone who resorts to them for information. It is difficult, indeed, to believe that the proofs ever passed through the author's hands. We find, for instance, "$E^2/2$" for E^2/α^2, "$\cos^2 \pi t/T$" for $\cos 2\pi t/T$, and are startled to learn that "$\cos r=2$." The description of the rock-forming minerals is expanded into a treatise on the entire mineral kingdom and little used terms like newjanskite and sysserskite are included, while we look in vain for the refractive indices and birefringence of the commoner rock-forming minerals. The classification and nomenclature of the igneous rocks is open to serious criticism, and is based to a considerable extent on chronological principles, for we are told:—"Les géologues répugneront longtemps à confondre sous le même nom des roches qui sont arrivées au jour à des époques si différentes."

It would have been a work of supererogation to enumerate the defects of a book published ten years ago, if the fourth edition, which bears the date 1910, had not proved on careful examination to be identical with its predecessor. It is not merely that the advances of science in the interval have been ignored, but that every inaccuracy in the third edition, however obvious to the most casual reader, is faithfully reproduced. A hiatus in a reference, represented by a line of points, is left still unfilled, and even the table of errata, which corrected only a fraction of the misprints, and added more of its own, remains word for word the same. Yet we are told that this is a new edition, "revue et augmentée." The revision consists,

it would seem, in the substitution of a fresh title-page, with a later date and the name of a different publisher, and the enlargement in the addition of eight reproductions of photographs, some at least of which do not appear for the first time.

Any value the book once possessed has now been greatly diminished by simple lapse of time, and the appearance of this reprint under the false colours of another edition can only be regarded as a breach of faith on the part of those who are responsible for it.

J. W. E.

ELEMENTARY MATHEMATICS.

(1) *The Public School Geometry.* By F. J. W. Whipple. Pp. xii+154. (London: J. M. Dent and Sons, Ltd., 1910.) Price 2*s.* 6*d.* net.

(2) *The Student's Matriculation Geometry.* By S. Gangopádhyáya. Second edition, revised and improved. Pp. xviii+348. (Calcutta: The Students' Library, n.d.) Price 1.4 rupees.

(3) *First Stage Mathematics.* Edited by W. Briggs. Pp. vii+194. (London: W. B. Clive, 1910.) Price 2*s.*

(4) *Second Stage Mathematics (with Modern Geometry).* Edited by W. Briggs. Pp. viii+128+102+186+14 (answers)+21 (exam. papers). (London: W. B. Clive, 1910.) Price 3*s.* 6*d.*

(5) *Conic Sections.* By S. Gangopádhyáya. Pp. viii+97. (Calcutta: The Students' Library, 1909.) Price 8 annas.

(6) *Public School Arithmetic.* By W. M. Baker and A. A. Bourne. Pp. xii+386+2. (London: G. Bell and Sons, Ltd., 1910.) Price, with answers, 4*s.* 6*d.*, without answers, 3*s.* 6*d.*

(7) *A School Algebra.* By H. S. Hall. Part I. Pp. xi+299+xxxvii. (London: Macmillan and Co., Ltd., 1910.) Price 2*s.* 6*d.*

(8) *Elements of Algebra.* By A. Schultze. Pp. xii+309. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1910.) Price 4*s.* 6*d.*

(9) *The Theory of Elementary Trigonometry.* By Prof. D. K. Picken. Pp. vii+48. (Wellington, N.Z., and London: Whitcombe and Tombs, Ltd., 1910.) Price 2*s.* 6*d.* net.

(1) FREE use is made in this volume of inductive methods in establishing the fundamental facts of geometry—the conditions for congruency and parallelism. The opening chapters deal with the measurement of lines and angles and with a few simple constructions. Then follow the elementary properties of the triangle and parallelogram, the usual theorems on inequalities, and a short account of areas. The principles of similar figures are then discussed, and are employed to prove Pythagoras's theorem. And the book closes with the angle and metrical properties of the circle. The author has succeeded in giving in a very concise form a useful summary of the subject-matter of the first six books of Euclid. We regret the introduction of two new terms—new at least so far as elementary text-books are concerned—the use of the word "stretch" for a segment of a straight line, and of the word "cognate" for "corresponding"; while the definition of π on p. 16 is not merely misleading but is incorrect. It is most important that the student should understand that π is a pure number and not an angle. There are a very large number of numerical examples, but most teachers will consider the supply of riders inadequate.

(2) The plan of this book conforms very closely to the syllabus for the matriculation examination at Calcutta, which is practically identical with the Cambridge schedule for the previous examination, the section on proportion being omitted. While due attention is paid to experimental and numerical work, the author has very wisely given chief place to the theoretical developments of the subject. We welcome the presence of a certain number of historical allusions, which might with advantage be increased in a future edition. Those who use this book will find that it answers with uniform success the purpose for which it was written. From its general workmanship it is evident that this volume comes from the hand of an experienced teacher.

(3 and 4) The two parts of this treatise are designed to meet the requirements of the Board of Education examinations in first- and second-stage mathematics. The first part therefore contains the substance of Euclid, book i., and the elementary algebraic processes as far as simultaneous and literal equations. In the second part will be found the substance of Euclid, books ii.–iv., the section on algebra including quadratics, indices, and proportion; the remainder of the volume provides the requisite course of trigonometry up to and including the solution of triangles by logarithms. We have no hesitation in saying that this text-book is admirably suited to the needs of those students who are reading by themselves for this examination, or any other of a similar character. The authors have made good use of their experience in anticipating the nature of the difficulties which the reader is likely to meet with, and in resolving them in a lucid and accurate fashion; and further, what is equally valuable, attention is directed to many points of logical importance which a student is apt to overlook, if working without any supervision. There is a rich supply of well-graded examples and a large number of examination papers, which furnish the student with opportunities for testing his progress.

(5) This book falls into three sections. There is first an introduction containing several preliminary lemmas, together with a few remarks of a general character bearing on geometrical procedure, the second part relates to the parabola, and the concluding chapter to the ellipse. The author has not aimed at giving a complete account of the geometrical properties of conics, but rather a selection of the more useful theorems, his objective being the syllabus for the Calcutta intermediate examination. This leads to some regrettable omissions; there is, for example, no mention of the auxiliary or director circle. Each proposition is followed by a number of simple applications and a few riders of a somewhat harder type are given at the end of each chapter. The book will serve as an admirable introduction to the subject. Among other good features we note the introduction of analysis at several stages, which is calculated to enlarge the outlook of the reader.

(6) There is little that differentiates this from the other numerous text-books on arithmetic which have appeared during the last few years. The supply of examples for oral and written purposes is plentiful, and a large number of test papers are provided. Although it is probable that those who use this book will find it thoroughly satisfactory, yet we do not consider that it marks any real advance on other recent publications of a similar nature.

(7) The present work is far more than a mere revision of Hall and Knight's "Elementary Algebra." Although some of the features of this book, first published twenty-five years ago, have been retained, yet the organic changes in method of late years demand alterations so considerable that the volume before us is to all intents and purposes a new book. It is marked throughout by the same clearness of style and thoroughness of treatment which characterised the author's earlier work. Graphical methods are employed, but it is satisfactory to note that they have been kept within reasonable limits. The tendency to allow it to expand into an elementary course of analytical geometry is a fatal error, for it overlooks the fact that the student is not sufficiently mature at that stage to be able to appreciate the significance of the theoretical aspect of the subject. We hope that this book will be widely used, for it is both sound and comprehensive. Part i. carries the reader as far as simultaneous quadratics. We understand that part ii. is to be published very shortly.

(8) It has often been pointed out that one significant feature of the influence of examining bodies on the educational curriculum is the tendency to standardise into distinct types, and to collect under separate headings, applications of general principles which the student should be so educated as to work out for himself, when required to do so. The old-fashioned text-books on arithmetic bear emphatic witness to this deplorable result; and it is of some importance to consider whether works on algebra are not similarly affected. This is not the place, however, to develop this theme; but in England it is satisfactory to note that the principles which have actuated those educational bodies which are responsible for the leaving certificate and Army qualifying examinations do much to minimise a very real danger. The author of the present volume attempts to meet the sitaution by focussing attention on the central facts and encouraging the reader to make the requisite applications for himself. By avoiding multiplication of detail, he is able to cover a wider range and prepare the student for more advanced work, in a shorter time than would otherwise be possible, without any sacrifice of principle. The explanatory matter is both full and clear, and there are many useful hints, particularly in connection with the solution of problems. We are, however, inclined to regret that the method of undetermined coefficients is omitted, and that the chapter on the binomial theorem is not prefaced by some quite short account of permutations and combinations, treated numerically. There is at the end of the book a useful collection of more than a thousand examples for revision purposes, which are rather harder than those given in the text. The author has done his work well, and his book deserves a good reception.

(9) There is much that is novel in the plan of this book. Broadly speaking, there are two types of text-books. In one the subject is presented in as simple and elementary a fashion as possible, with no attempt at investigating the fundamental axioms and principles on which the theory is based, and in the other a substantial knowledge of the actual analytical results is assumed and attention is concentrated on the formal concepts. Both of these are beneficial, when properly used. In the study of elliptic functions, for example, it is customary to approach the subject by considering such cases of integration which do not lead to any known elementary function; but when the student has acquired a knowledge of the general results, it is very valuable to start again and take as the base the theory of a doubly-periodic function. Prof. Picken has set himself the task of compiling a book for those who are actually starting trigonometry during their university course. His contention is that such students will have attained a maturity of mind which will be fully capable of appreciating the theoretical principles of this subject, and his object is therefore to supplement the ordinary school treatises which refer almost exclusively to numerical applications. We have little doubt that the class of students the author has in view will materially benefit by his work, which, although brief, is both lucid and scholarly.

OUR BOOK SHELF.

Milch und Molkereiprodukte, ihre Eigenschaften, Zusammensetzung und Gewinnung. By Dr. Paul Sommerfeld. Pp. 140. (Leipzig: Quelle and Meyer, 1910.) Price 1.25 marks.

THIS little book forms one of a series entitled "Wissenschaft und Bildung," the object of which is to present the intelligent reader with brief accounts of particular subjects. It is rather more technical than our own popular books of the same size would be, and naturally it lacks the completeness of a monograph. But it would prove distinctly useful for a large class of readers, including students and lecturers at agricultural colleges, and farmers who take more than a commercial interest in their work. It seems, indeed, to be a very useful method of dealing with a complex subject like agriculture.

The first chapter describes the constituents of milk, giving a clear and concise account of the protein, carbohydrates, fats, and mineral matter present, and then follows a section on the characteristics of milk from various animals. In discussing human milk some interesting statistics are given that show how difficult it is to supply any artificial food to infants that shall take the place of the mother's milk. In Berlin during 1905 the total number of infants dying under twelve months of age was 10,170. The method of feeding 7738 of these was known; 7064 had been fed on cow's milk and only 674 on human milk. The figures for other years are similar.

The chapter devoted to the bacteriology of milk is subdivided into three portions, dealing respectively with fermentation organisms, with organisms producing disease in man, and with organisms producing taints or defects in milk, such as ropiness. As all this is compressed into less than twenty pages the treatment is necessarily very brief.

Lastly, there comes a well-illustrated section on milk products and the methods of working them up for market. So important is cleanliness in working that several pictures are given of modern cow-sheds built on the best possible principles; in one, indeed, the cowman is shown cleansing the cow with a special vacuum cleaner! This section will probably prove most interesting to English readers, as it gives fairly full outlines of the German factory methods.

A few misprints are inevitable, but how did this wonderful piece of Greek on p. 12 pass the proof-reader "kohlenhydrate (von λγδορ hydor = griechisch wasser)"? E. J. R.

Theoretical Mechanics. By P. F. Smith and W. R. Longley. (Ginn.) Price 10s. 6d.

UNTIL the student has acquired a certain manipulative dexterity, it is impossible to preserve a proper continuity of thought in the development of the application of infinitesimal theory of mechanics or any other applied science. The authors are therefore justified in assuming that the reader comes to this subject equipped with a thorough working knowledge of the methods of the calculus. In the opening chapter a good account is given of the means for obtaining centres of gravity and moments of inertia of plane and solid figures; no mention is made, however, of the application of orthogonal projection to the theory of the centroid. Chapters ii.–iv. deal with the principles of rectilinear and curvilinear motion in a most attractive fashion; as an example, the motion typified by $x = a \cos kt$ is considered, the equation $d^2x/dt^2 = -k^2x$ is deduced, and the properties of harmonic motion are then obtained in a simple fashion; a similar treatment is applied to damped vibrations. This is followed by an exposition of work, energy, and impulse. Chapters vi.–ix. discuss the motion of a particle under constant forces, central forces, in a harmonic field, and against a resisting medium. The volume closes with a brief account of the equations of rigid dynamics and the principles of equilibrium of a coplanar system of forces with special reference to the catenary.

The examples, which are very numerous, are mainly numerical and practical, and so chosen as to require a minimum of analytical power. This feature renders the book eminently suitable for the senior divisions of secondary schools, where the true understanding of the ideas of mechanics is the chief object. It is to be regretted that practically no English text-book has treated the subject on these lines, a fact which is due mainly to the action of the universities in excluding the simpler applications of particle and rigid dynamics from their entrance scholarship examinations. We hope that the time is not far distant when this restriction will be removed.

The Anatomy of the Honey Bee. By R. E. Snodgrass. (U.S. Department of Agriculture, Bureau of Entomology, Technical Series, No. 18.) Pp. 162. (Washington: 1910.)

IN this modest pamphlet the author has given to entomologists an original, trustworthy, and excellently illustrated account of the structure of the honey bee, and another instance has been furnished of the scientific thoroughness that characterises the publications of the United States Department of Agriculture. Many volumes have been written on the honey bee, yet no surprise can be felt that Mr. Snodgrass has been able to add new points to our knowledge and to correct errors in the work of his predecessors. A feature of value to the serious student is the general survey of the external structure of a typical insect which the author has wisely given as an introduction to his account of the highly specialised modifications to be found in the bee. He expresses scepticism as to certain positive statements that have been made on controverted details of physiology and reproduction; for example, "concerning the origin of the royal jelly or of any of the larval food paste . . . we do not know anything about it." There is a present-day tendency unduly to disparage the results obtained by former workers, and such a statement will strike many readers as extreme. Mr. Snodgrass's scepticism as to the parthenogenetic nature of "drone" eggs seems also unwarranted after the support which Weismann's researches, published ten years ago, afford to the generally accepted view. G. H. C.

Practical Physiological Chemistry: a Book designed for Use in Courses in Practical Physiological Chemistry in Schools of Medicine and of Science. By Philip B. Hawk. Third edition, revised and enlarged. Pp. xviii + 440. (London: J. and A. Churchill, 1910.) Price 16s. net

BOTH the first and second editions of Prof. Hawk's volume have been reviewed in these columns; the former in our issue of July 18, 1907 (vol. lxxvi., p. 268), and the latter in that of July 15, 1909 (vol. lxxxi., p. 67). The present edition has been brought up to date by the insertion of various additions and corrections, as well as by the inclusion of a number of qualitative tests and quantitative methods.

LETTERS TO THE EDITOR.

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Simulium Flies and Pellagra.

IN reference to Mr. Shelford's letter in NATURE of November 10, in which he directs attention to the difficulties in controlling and eradicating the flies of the genus Simulium, known generally as sand flies and black flies, it may be of interest to direct attention to certain experiments carried out in New Hampshire by Dr. C. M. Weed and Prof. E. Dwight Sanderson and their assistants in the control of these insects. The southern buffalo gnat, *Simulium pecuarum*, Riley, which attacks and kills many animals, such as horses, cattle, mules, sheep, poultry, dogs, &c., is well known. In certain parts of the United States, but especially in Canada, "black flies," generally *S. hirtipes*, Fries, and *S. venustum*, Say, make life far more intolerable than mosquitoes, and they are specially annoying when they occur in such resorts as the White Mountains.

In 1903 Dr. Weed and his assistant, Mr. A. F. Conradi, showed that the Simulium larvæ, although they live on the stones in running water, could be killed by the application of Phinotas oil. The destruction was so complete that the flies were practically eradicated in the locality in which the experiments were carried out (see "Experiments in Destroying Black Flies," Bull. No. 112 New Hampshire Agric. Exp. Sta., 1904). A floating oil such as kerosene is manifestly useless for the destruction of larvæ having such habits as Simulium, and the efficacy of Phinotas oil is due to the fact that it has the property of sinking to the bottom in water, thus destroying the larvæ which are stationary on the stones. Further experiments have been carried on more recently in the White Mountains by Prof. E. Dwight Sanderson, and he also found that Phinotas oil applied to the running streams was effectual in the destruction of the Simulium larvæ (see "Controlling the Black Fly in the White Mountains," E. D. Sanderson, *Journal Economic Entomology*, vol. iii., p. 27, 1910). There still remains, however, much experimental work to be done with regard to the effect of the oil upon the fish, the details of the life-histories of the species of Simulium, and the practical methods to be used in applying the oil.

If Dr. Sanbon's results are confirmed, and the Simulium

theory is certain to form the basis of a careful and complete series of investigations, not only in Europe, but also in those regions in Africa and America where pellagra also occurs, these experiments and results on the destruction of the Simulium larvæ will be of no little practical importance in the prophylaxis of the disease, whether a definite pathogenic organism is discovered, or the case proves to be analogous to that of Stegomyia or yellow fever.

C. Gordon Hewitt.

Division of Entomology, Ottawa, November 21.

The Song of the Siamang Gibbon.

The Zoological Society has recently received on loan an almost adult example of the siamang (*Symphalangus syndactylus*); and since I can find no adequate description of the voice of this ape in the books I have consulted, I think the following description may be interesting to readers of Nature.

The siamang differs from all other gibbons in having a pair of laryngeal vocal sacs visible externally on the throat as an undivided pouch of loose skin. When the animal is in full song the pouch becomes inflated into an immense oblate spheroid much wider from side to side than from above downwards, and comparable in size to the entire head of the gibbon. A feeble imitation can be made of the booming that comes from this pouch by uttering a guttural monosyllabic "*ooo*" with cheeks inflated and lips compressed. It is not unlike the sound produced by a large bubble of air bursting on the surface of water confined in a narrow space like a rain-water pipe. In addition to this there are two very distinct cries apparently quite independent of the vocal sac and uttered with the mouth open. One is a shrill, piercing bark, like the monosyllable "*haow*," cut off sharply by the abrupt closing of the lips. The other is a prolonged, unearthly wailing shriek—"*ahh—o*"—resembling more than any familiar sound to which I can compare it the "*miaou*" of a cat multiplied ten times in volume. It starts on a high pitched note with the mouth widely astretch, and gradually descends the scale as the jaws are closed. There are two variations of this shriek, one being a note or two higher and more piercing than the other.

The song usually begins with a low and gentle booming punctuated by an occasional staccato bark. As the excitement rises the ape starts to move, and swings round the cage barking vigorously and repeatedly, and now and again uttering the wailing shriek, the loud booming from the now fully expanded vocal sac going on all the while like a resonant bass accompaniment. The noise is deafening and terrific, and I shall not easily forget the consternation of the chimpanzees and the look of mild surprise that pervaded the usually expressionless faces of the orang-utans when they heard it for the first time in the apes' house.

The voices of Mammalia have never, I believe, been carefully studied and compared; yet they are worthy of the closest attention as a criterion of specific relationships. The cry of the siamang, for instance, is quite different from that of the Hainan, Hoolock, and Wau-wau gibbons, and each of these species has its characteristic song. I have elsewhere pointed out that the bray of Grévy's zebra betrays pronounced asinine affinities, and equally forcibly attests remoteness of kinship between that species and the quaggine Equidæ; that the likeness between the roar of the lion and the tiger on one hand and of the jaguar and the leopard on the other confirms the conclusion that these species are respectively closely allied, and that these four great cats form, with the probable inclusion of the ounce, a special group of Felis characterised by a roaring voice correlated with a peculiarly modified hyoidean apparatus; that the friendly purr practised by the puma, cheetah, caracal, common cat, and other species which, be it noted, never roar, distinguishes them from lions, tigers, and leopards, which never purr. To the casual observer the Cape hunting dog (Lycaon) is more like a hyæna than a wolf, but the moment he barks and growls it is needless to look at his teeth and skull to detect his cousinship to Canis; and I have recently noticed identity in all essential respects between the raucous growl of a frightened cervine wallaroo (Macropus) and that of a nervous Tasmanian wolf (Thylacinus). In this last instance we have vocal likeness associated with deep-seated ordinal resemblances, and apparently persisting despite great divergences in other structural features and in habits.

Zoological Society.

R. I. Pocock.

On the Simultaneity of "Abruptly-beginning" Magnetic Storms.

In the first number of *Terrestrial Magnetism and Atmospheric Electricity* for the present year, Dr. Bauer has written two papers, in which he believes he can prove the following (p. 20):—

"Magnetic storms do not begin at precisely the same instant all over the earth. The abruptly beginning ones, in which the effects are in general small, are propagated over the earth more often eastwardly, though also at times westwardly, at a speed of about 7000 miles per minute, so that a complete circuit of the earth would be made in $3\frac{1}{2}$ or 4 minutes."

Dr. Bauer bases this result upon an investigation of two magnetic storms of Birkeland's "positive equatorial" type, namely, the storms of May 8, 1902, and January 26, 1903. In the latter he makes use of a table in Birkeland's "The Norwegian Aurora Polaris Expedition, 1902–3."

In the following number Dr. Faris made a more thorough investigation of this circumstance, taking fifteen different abruptly beginning storms, recorded at the Coast and Geodetic Survey magnetic observatories, in which he considers that he found Dr. Bauer's result confirmed.

Upon this foundation Bauer then develops the "Ionic Theory of Magnetic Disturbances" (*loc. cit.*, p. 111), of which the principal advantage over Birkeland's corpuscular theory is supposed to consist in the being able to give a natural explanation to time differences such as these, which Birkeland's theory, in his opinion, cannot do.

Notices of these papers appeared in Nature of August 11.

As it appears that a number of the perturbations described by Dr. Faris are some that I studied last summer when making an investigation of magnetic equatorial storms at the magnetic observatory in Potsdam, a comparison may be of some interest. I determined also the time of the commencement of a number of positive equatorial storms as accurately as possible for another purpose, and without any knowledge of Dr. Faris's work, so that the measuring of the time was entirely independent of it, a circumstance which may be worthy of note.

It may be remarked with regard to the exactness with which the time can be determined by the Potsdam curves that the length of an hour upon the magnetograms is about 20 mm., and that thus one minute answers to about $\frac{1}{3}$ mm. If we then take into consideration all the errors that may creep in because the curves, the time-marks, and the points considered are not so sharply defined as might be wished, and further all the errors that may be due to changes in the paper in developing, owing to the fact that the paper has perhaps not laid quite straight on the roller, &c., it will be evident that where there are no exact automatic time-marks upon the curve itself, one minute will at any rate be the *lowest* limit for the accuracy that under favourable conditions can be counted upon.

There might very easily be an uncertainty of several minutes if, for instance, the base-line is not exactly straight, but is slightly curved, if the parallax cannot be determined exactly, and so forth. Unfortunately, neither Dr. Bauer nor Dr. Faris has stated anything as to how the time in the various cases can be given exactly, a point upon which, it would be thought, it was highly important to be clear.

In the equatorial storms that I have studied, and especially those that are also found in Dr. Faris's Table I. (*loc. cit.*, p. 101), the point at which they commenced is especially clear in H. The deflections in D and Z, on the other hand, are very slight, and in consequence the beginning there is far less clearly defined.

It is therefore the beginning in H that is especially suitable for employment in a comparison such as this, and this was what I especially investigated. It will *a priori* be perceived that the results obtained by employing the other two components must be far more uncertain. In the table below I have compared the means of the values found by Faris for the five American stations that he has considered with those I measured out by the aid of the

Potsdam curves. Finally, I have also given the difference (d_r) between the greatest and the smallest time given in Faris's Table I. for the commencement in H at the American stations (Greenwich mean time is employed).

Date	America h. m.	Potsdam h. m.	Diff. m.	d_r m.
1906, July 29	19 56·12	19 57	−0·88	3·7
1907, ,, 10	14 22·92	14 22·5	+0·42	3·8
,, Oct. 13	7 42·36	7 42·5	−0·14	3·9
1908, Sept. 11	7 20·82	7 20·3	+0·52	1·3
,, ,, 28	8 42·00	8 42	0·00	2·3
,, ,, 29	1 31·68	1 31·8	−0·12	3·4
Mean			−0·03	
Mean of numerical values			0·35	3·07

It will be observed that all the differences are considerably below the error-limit which, according to the above, must be reckoned upon, and the difference is as frequently one way as the other.

These figures seem to me to show clearly that in these cases the magnetic impulse occurs, at any rate, very nearly *simultaneously*; in any case there cannot be time-differences of such a magnitude as in Dr. Faris's opinion there are—for July 10, 1907, he even assumes that the storm would take 11·6 minutes to encircle the earth. Further, we see that the *greatest* difference between Potsdam and the mean of the American stations, 0·88m., is only about two-thirds of the *smallest* difference, d_r, between the times at the American stations, 1·3m. This circumstance, and the fact that the relation between the numerical means of these time-differences is as 0·35 : 3·07, would seem distinctly enough to show that the great time-differences observed by Dr. Faris can only be due to inaccuracy in the determination of the time, and that the error-limit must be considerable.

Further, if we consider the foundation that Dr. Bauer has employed for the determination of the rate of propagation in the case of the storm of January 26, 1903, it must, I think, be deemed as weak and uncertain as the above-mentioned, which I was able to control. Birkeland, in speaking of the table employed (*loc. cit.*, p. 63), says:—

"The table shows that the time varies so little with the geographical position that it would be premature to draw conclusions from it. The slight differences may be ascribed to inaccuracies in the determinations of time on the magnetograms; for we see that if a difference in time for a certain point appears between two places, this difference is maintained for all the points, a circumstance which seems best to be explained by an inaccuracy in the statement of the time. We may conclude from this that the serrations appear simultaneously, or rather, the differences in time are less than the amount that can be detected by these registerings. . . . The above question, which is of great importance, cannot be definitely decided until we are in possession of rapid registerings."

Bauer holds, however, that by taking groups of means he can demonstrate, clearly and surely, time-differences that would prove that the cause of the perturbation was transmitted eastwards at a rate of 6400 miles per minute.

I also last summer determined the commencement in H of this perturbation in Potsdam, and found the time to be 8h. 53m. Greenwich mean time. I moreover had the opportunity of going through the curves upon which Birkeland's table was based. From these it appeared that the times for the comparative correctness of which there was some guarantee were from the five following places:—Toronto, Kaafjord, Potsdam, Dehra Dun, and Bombay. As regards the other stations, it may be remarked that from Honolulu, Baldwin, and Cheltenham there were only received Indian-ink copies without hourly or two-hourly automatic time-marks. The parallax there could not be determined accurately, and the uncertainty in the time-determination must be considered to be relatively very great.

In the copy of the curve for San Fernando the base-line was a little curved. In that for Batavia the curve and the base-line were very faint; the parallax could not be determined with sufficient precision, and the time-marks were also rather indistinct. A new determination of the time of beginning which I have just made gives as the result 8h. 52·4m. for San Fernando and 8h. 52·8m. for Batavia. In the table these times are given as 8h. 54·3m. and 8h. 54·9m. respectively, a fact that demonstrates the uncertainty which attaches to these hours. At Christchurch it seems from the D and Z magnetograms as if the clock on that day was about 1·5 minutes too fast, so that the value 8h. 54·8m. given in the table probably should be reduced to about 8h. 53·3m. Further, the beginning of the base-line and the time-marks for the H curve were rather unsharp.

In addition, it may be remarked that the thickness of the curve at Bombay was considerable, about 0·9 mm., thus causing the commencement of the storm to be somewhat less clear; but, on the other hand, there were two-hourly automatic time-marks upon the curve itself, a circumstance which is of great importance in exact determinations of time.

If we now omit those that we already know to be very uncertain, we find the following times of beginning, putting Dehra Dun and Bombay together:—

Toronto	Kaafjord	Potsdam	Dehra Dun and Bombay	Diff.
8 52·6	52·6	53	53·3	0·7

Thus the greatest difference is considerably lower than the error-limit, and this would be still less if, as would indeed be best, we attach more weight to Dehra Dun, where the curve is exceedingly clear, than to Bombay. If we attach double the importance to the former, we find 53·1m. instead of 53·3m., and the difference will then be reduced to 0·5m.

It seems to me, also, that this last method, where the conditions are as they are here, must give a far more certain result than that which Bauer has employed.

The remaining characteristic points on the curve seem to me to be too indistinctly defined to allow of being employed in cases where the differences are as small as they are here.

Of the storm of May 8, 1902, I have no special observations that could serve to control Bauer's result. As regards Potsdam, however, I have a determination of its beginning in H, which I also made last summer before reading Bauer's paper. I found the time to be 11h. 58m. Greenwich mean time. Bauer, however, in his table gives it as 12h. 0m. It seems to me that this difference of two minutes is characteristic of the uncertainty that attaches to these statements. When Bauer finds that the weighted mean of all European stations is 11h. 58·24m., it looks as if my determination were the best. When such great differences can be found in the measurement of the same curve, and the Potsdam curves must, I suppose, be considered to be among the most trustworthy of all, how great must be the uncertainty that attaches to the others?

There seems from this, at any rate, to be by no means sufficient data to justify the conclusion that the magnetic storms are generally propagated round the earth in from about 3½ to 4 minutes, and the theory that Bauer mainly bases upon this we must be allowed to regard with corresponding scepticism.

But even if there are no such great time-displacements in these "abruptly beginning storms" as Bauer thinks, there is, of course, a possibility that small time-displacements might exist. This question, which is of such great importance for a full comprehension of the nature of the magnetic storms, can only, however, in my opinion, be solved, as Birkeland has suggested, by rapid registerings. It would be comparatively easy, moreover, to carry some such arrangement into effect by means of a number of stations—at least three—where a short or long period was registered continuously with *very sensitive apparatus* and with frequent and exact *automatic time-marks upon the curve itself*. This was the more easy of accomplishment from the fact that, for the solution of the present question, it was only necessary to register H in this manner. It would then be possible to obtain a sure foundation for reflections of the kind that Bauer makes in his last paper, reflections that, however interesting they may be, must, from what I can understand, be said to be in no small degree premature.

O. KROGNESS.

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THE NEGRO IN THE NEW WORLD.[1]

WHEN, more than four centuries ago, the Portuguese obtained the sanction of the Roman Pontiff to engage in the African slave trade, and, some years later (Treaty of Tordesillas in 1494), Pope Alexander VI. assigned to Portugal the west coast of Africa and to Spain the New World (of which Portugal claimed Brazil, in accordance with the terms of the treaty), it could not have been foreseen that these acts were the first steps in the vastest anthropological experiment the world has ever witnessed, the effects of which for many ages to come are likely to confound and confuse the politics of the Americas. In Portugal itself the population has been transformed into Africanised mongrels, who at the present moment are busily engaged in casting out the representatives of the church that permitted them to begin the process of wholesale racial admixture four hundred years ago.

Negro slavery and the breeding of a mulatto population were by no means novel phenomena in 1494, for even then Egypt had been familiar with them for forty-five centuries; and, in less remote times, Arabia and western Asia, Greece, and Rome, Tunis and Morocco were only too familiar with the black slave and the half-caste. But the coincidence of the introduction of negro slaves into Portugal and the opening up of the New World by the two peninsular kingdoms makes the beginning of the sixteenth century—for the experiment of sending negroes to the West Indies began in 1516—a landmark in the history of the world.

Sir Harry Johnston has given a very complete history, without sparing us any of its appalling horrors, of the iniquitous traffic in black slaves, which ultimately led to the transference from one side of the globe to the other, and that a new continent, of a population (whose descendants now number twenty-five millions), which had grown up in the seclusion of the heart of Africa and had there become divergently specialised from the rest of mankind in bodily structure and mental and moral qualities. He has drawn a most graphic picture of how these negro people behaved in their new home, as they came into contact successively with the aboriginal Americans, and also the Iberians and the northern Europeans, who had settled in the New World.

Nothing has surprised the "lay" reviewers of this book in the newspaper press more than the revelation of the gross inhumanity of the representatives of the north European race (the English and the Dutch) towards the negro slave, when contrasted with the more generous behaviour of the Iberian and other Mediterranean peoples. Lamentable and indisputable as is the fact, the explanation is simple enough. The Mediterranean race was evolved and fashioned in an environment similar to, and perhaps in the same continent as, the African negro, and not only developed mental and moral qualities in many respects closely resembling those of the negro, which explains their mutual understanding the one of the other; but also the black and the brunet race had been in contact for many ages, had interbred, and had come to give equal rights to the offspring of mixed unions.

The blond people of the north, the representatives of a more austere civilisation, had nothing in common with the lazy, lascivious negro, and had no knowledge of or sympathy with him. Thus they came to treat him and his offspring, whether pure or mixed, as an inferior being of low intelligence and dirty habits.

When Mr. Roosevelt (at the time President of the United States) invited Sir Harry Johnston to undertake an investigation of the problems of the negro in the New World, he could not have chosen anyone to accomplish this task better fitted by personal knowledge and exceptionally wide experience of the negro in his native haunts.

Others may possibly have had equal opportunities

FIG. 1.—Type of the Virginian Negro of Slavery Days. From "The Negro in the New World."

of studying the negro in Africa, but certainly no one has made such excellent use of them as Sir Harry Johnston, who has already written eleven volumes on the subject.

With such an intimate knowledge of the essential negro, Sir Harry Johnston was well equipped for the examination of his behaviour under the influence of his altered surroundings in the New World.

In this book he has given us a detailed account, illustrated by maps and hundreds of excellent photographs, of the nature of each territory in the New World occupied by negroes or negroids, its commercial resources and social conditions, the place occupied in it by the black man, and especially the half-caste, and the degree of success and the possibilities for the

[1] "The Negro in the New World." By Sir Harry H. Johnston, G.C.M.G., K.C.B. Pp. xxix+499. (London: Methuen and Co., Ltd., 1910.) Price 21s. net.

future in ameliorating the lot and uplifting the coloured people, socially and morally.

Although no one is more fully aware than Sir Harry Johnston of the failings and moral weaknesses of the negro, he takes a very hopeful view—which many persons with a less intimate knowledge of the black man may think unreasonably sanguine—of his future, and especially of the hybrid's prospects, in the New World, provided only that he follows the example and teaching of his great and wise leader, Dr. Booker Washington, who "wants the negro to become the most industrious race in the United States" (p. 407), because only work will exhaust his energies and keep him out of mischief.

The book starts with a statement of Sir Harry Johnston's views on the negro's place in nature, which for the most part are well known to readers of his other books.

It is unfortunate, however, that on the very slender basis of the evidence afforded by the skeletons in the Grimaldi caves (see p. 26) he extends the habitat of

Fig. 2.—Type of Modern Negro; an electrical engineer trained at Tuskegee. From "The Negro in the New World."

the negro over half the continent of Europe and the whole of the British Isles!

It is not as a work of science, however, that this work, with its introductory *vulgarisation* of anthropology, is to be judged, but as a book of exceptional interest, and as the reasoned judgment of a man of wide experience on one of the most difficult sociological problems of the present time.

G. Elliot Smith.

GEOLOGICAL CHRONOLOGY.[1]

The vexed question of the age of the earth has passed through several distinct phases. Lyell and his contemporaries, accustomed to dwell on the extreme slowness of geological processes, considered themselves free to make unlimited "drafts on the bank of time"; but, since 1862, this position has been seriously challenged from the physical side. The chief argument brought against it was that, granting the globe to have cooled from a molten state, it would attain its assumed present thermal condition in a few scores of millions of years, only a fraction of which time would be available for the stratigraphical record. If the general body of geologists, influenced by the high authority of Lord Kelvin, have tried to adapt themselves to this narrow limitation, it has not been without reluctance, and some sturdy dissentients have refused any such coercion. To these, during the last few years, welcome support has come from unexpected quarters. The nebular hypothesis of the earth's origin, upon which the estimates of Kelvin and King were tacitly based, has been shaken by Moulton's calculations and other arguments put forward by Chamberlin. Moreover, the remarkable discoveries in the domain of radio-activity have compelled a reconsideration of the thermal state of the globe. Estimates of the earth's age deduced from its supposed rate of cooling clearly become futile if we have no good reason for believing that the earth is a cooling body. On the other hand, from the radio-active properties of various minerals Strutt has deduced geological ages liberal enough for the most extreme uniformitarian.

The debate concerning the age of the earth is thus no longer an issue between geologists and physicists, since the newer school of physics has declared on the side of the ampler chronology. Meanwhile, there has arisen within the body of geologists a formidable minority who contend, on geological grounds, for an estimate of geological time no more elastic than that imposed by the old argument from refrigeration. The discussion has followed two distinct lines, starting on one hand from the rate of accumulation of sediments, and on the other from the rate at which sodium is carried down by rivers into the sea. The interesting memoirs by Mr. Clarke and Dr. Becker, recently published by the Smithsonian Institution, deal mainly with the second mode of approaching the problem, but Becker offers also a revised estimate of the earth's age as calculated from the rate of cooling.

In 1899 Prof. Joly made estimates, first, of the total amount of sodium contained in the ocean, and, secondly, of the amount annually carried down by rivers, and, dividing the one by the other, obtained the quotient 97,600,000 years as the age of the ocean, supposed to be initially of fresh water. If the sea contained some salt from the beginning, this figure must be reduced accordingly. The choice of sodium is dictated by the consideration that this constituent is less removed from sea-water than any other. A relatively small correction is made for salt carried inland by the wind, and it is assumed that there is no other process of importance by which sodium is being continually removed from the oceanic waters. We may note in passing that certain observed facts, such as the evident chemical action of sea-water upon potash-granites, throw some doubt upon this assumption.

The data at Joly's command were very defective, and the main object of Clarke's memoir is to revise the calculation in the light of more recent information. In particular he has drawn upon the large mass of observations relative to the discharge, drainage-areas, and salinity of American rivers contained in the Water-Supply Papers of the United States Geological Survey. He has brought together the available information on the same points for other parts of the world, and indicated where additional observations are especially desirable. The "denudation factor," *i.e.* the number of metric tons annually removed in solution from each square mile of a drainage-basin, varies from 105 for the St. Lawrence to 16 for the Nile, and the

[1] "A Preliminary Study of Chemical Denudation." By F. W. Clarke. Pp. 19. Smithsonian Miscellaneous Collections, vol. lvi., No. 5. (Washington, 1910.)

"The Age of the Earth." By G. F. Becker. Pp. 28. *Ibid.*, vol. lvi., No. 6. (Washington, 1910.)

relative amounts of the different dissolved salts also vary widely, these variations being related to climatic and lithological differences. Clarke computes the amount of sodium annually carried down by rivers to be 175,040,000 metric tons, and the total amount of sodium in the sea $14,130 \times 10^{12}$ tons, which gives as a quotient 80,726,000 years. He apparently considers possible corrections to be unimportant, or to balance one another, for he believes this crude quotient to be "as probable as any other value that might be chosen." As representing the age of the ocean, he considers this figure, for reasons set forth in Becker's memoir, to be "certainly a maximum."

The fundamental weakness of all such calculations, whether based on sedimentation or on solvent erosion, lies in the assumption that the present annual rate represents with sufficient approximation the mean rate throughout geological time. To the present writer this consideration deprives the conclusions of even a remote relevance to the actual problem. We know, for instance, that, even during the accumulation of a single formation at a given spot, the rate of deposition may vary widely, and in a shallow-water formation may be at one time positive and at another negative. To accept the thickness of a formation as a measure of its time of accumulation, with whatever qualifications and allowances, must inevitably lead to error, and probably to a greatly exaggerated estimate of the rate of sedimentation. Like reasoning applies to all processes of chemical as well as mechanical erosion and deposition, which are necessarily controlled by varying conditions. Even if we could eliminate the effects of relatively rapid and local variations, we have still to consider probable secular changes and others of a broadly periodic kind.

A partial recognition of this side of the problem has led Dr. Becker to discard Joly's assumption of a constant rate of increment of sodium in the sea, and to adopt instead a secular change of rate. He lays stress on the fact that at present the felspathic rocks are, over great areas, covered with a blanket of rotten rock in place, which contains only a negligible amount of sodium; and he pictures a distant future, when all massive rocks may be decayed down to sea-level, and addition of sodium to the ocean will practically cease. He thus reaches the remarkable conclusion that the rate of increment of sodium in the sea is progressively *declining*, and he accordingly represents it by a descending exponential expression. The age of the ocean is calculated, according to different hypotheses, as from 74·4 millions of years. The argument is not one which is likely to convince geologists. A decayed crust covering large continental areas must certainly have existed at many past epochs, and, indeed, the present time seems to be peculiarly favoured, in that extensive tracts have been recently scoured by ice. Further, stratified deposits yield more sodium, per square mile, than crystalline rocks, and, throughout geological time as a whole, the sediments have certainly made an increasing proportion of the whole land-surface. Most geologists believe, moreover, that the total area of land-surface has, on the whole, been growing. It would be possible, therefore, to make out a strong case for a secular *acceleration* of the rate of addition of sodium to the sea. There is another consideration of even more weight. The larger vicissitudes of the earth's history indicate a certain rough periodicity, and there is good reason to believe that we are living in a time of geological activity above the average. The author himself remarks that the continents stand at present above their average level, which, of course, greatly promotes erosion; and he also recognises that the recently glaciated regions of the globe are contributing soduim to the ocean at a rate which must raise the average. Unfortunately, he is content to leave these important considerations without discussion, assuming that they are sufficiently offset by an increased marine erosion.

The second part of Dr. Becker's paper, in which he revises Kelvin's refrigeration argument, we must pass over very briefly. It is ingenious in treatment, but involves too many precarious hypotheses to carry much weight. The special feature is that no assumption is made relative to the present superficial temperature-gradient. This is eliminated by making use of Hayford's "level of isostatic compensation," which is computed to lie at a depth (71 miles) beyond any disturbance from radio-activity. Of several special cases considered, the author prefers one which gives sixty million years since the *consistentior status*, and leads to a present temperature-gradient of 1° F. in 77 feet. We may take this latter value as a crux of the whole argument. Dr. Becker remarks that it is low as compared with observation, but he fails to see that, for the gradient *due to refrigeration*, it must certainly be far too high. Here at least radio-activity cannot be left out of consideration, and, indeed, Strutt has maintained that the observed gradient can be wholly accounted for by heat generated in the outer crust of the earth. If we allow some fraction of the annual loss of heat to represent secular cooling, it still appears that the age of the earth must be enormously greater than any estimate included in Becker's supposititious cases.

A. H.

PROF. ANGELO MOSSO.

THE School of Physiology in Leipzig was the Mecca that attracted young men from all quarters of the globe to study physiology under that great master, teacher, and experimenter, Carl Ludwig. A steady stream of young, ardent, able, and talented students crossed the Alps from Italy to prosecute research and acquire a knowledge of the methods in use in the Leipzig School. Amongst the earliest of these Transalpine scholars was L. Luciani—happily still amongst us—and a little later came Angelo Mosso, one of the most illustrious of Italian physiologists, whose death at the age of sixty-four the whole physiological world to-day deplores. He was born on May 31, 1846, in Turin. After studying at his native university—with no advantages of wealth, fortune, or high social position—he, by the exercise of his own high intellectual and brilliant gifts, soon became distinguished amongst his compeers, and he was selected by Moleschott to be his assistant in the university. He also acted as assistant to Prof. M. Schiff in Florence.

Before coming to study under Ludwig in the early 'seventies of last century, Mosso had already published his well-known researches on the movements of the Œsophagus, and determined in the dog the weight that could be lifted in the process of swallowing an olive-shaped ball (1872). In fact, the study of movements of all kinds always proved to him a fascinating and fertile subject of study. At an early period of his career he made observations on the movements of the Iris, and he attributed part of the change in size of the pupil to the filling of the blood-vessels of the membrane itself. Ludwig set him the problem to study the peculiarities of the movements of the vascular wall as they can be inferred from the results of the perfusion of blood through an excised organ, such as the kidney, a method which already had yielded such brilliant results in other organs. His results were published in 1874.

Another subject of study was plethysmography. A. Fick previously had used a plethysmograph to study variations in the volume of an organ. Mosso, under Ludwig's direction, modified this apparatus, and made an elaborate study on the alterations of the volume of the human limbs under various conditions, mental and physical, or with intellectual work, for the volume of a limb does vary with mental work, as Mosso conclusively showed. Later on, years after his return to Italy, in 1884, he published his famous paper on application of the balance to the study of the circulation in man. He constructed a balance so subtle that when a person was extended on it and delicately poised, mental work caused the head end to descend from an afflux of blood towards the brain.

In 1876, after his return to Italy, Mosso became professor of pharmacology in Turin. In 1880, when Moleschott was called to fill the chair of physiology in Rome, Mosso succeeded his old teacher as professor of physiology in Turin, a post he held with the highest distinction until his death. During the last few years illness incapacitated him from working in his laboratory, a matter of the acutest mental anguish to one whose untiring brain had ever new problems to investigate and solve.

The fact that in search after health he was able to devote his enforced leisure to the study of the result of excavations made in Sicily, and, above all, in Crete, was some compensation. He has left behind him a standard work on prehistoric anthropology in his "Palaces of Crete," published in English in 1907. His first laboratory was in a convent, but his boundless activity, productiveness, and the increase in the number of scholars, as well as the growing importance of his subject, led the Government to provide him with a palatial laboratory, one of the finest, most artistic, and æsthetic and best equipped in Europe. In 1882, along with Prof. Emery, he founded the well-known "Archives italiennes de Biologie," in which many of his now classical investigations were published. The first volume contains, Bizzozero's article on the blood platelets, and that of Mosso and Pellacani on the movements of the bladder. His unrivalled activity found vent in many directions in physiology; nor was this all. He was elected a senator, and often travelled to Rome to Monte Citorio to attend to his parliamentary duties, returning at night to undertake his more academic duties in Turin next morning.

The physiology of respiration early, and indeed constantly, occupied his attention. He studied the relations between abdominal and thoracic movements in 1878, periodic respiration, Cheyne-Stokes breathing in 1886. He had a special laboratory in the Regina Margherita hut on the top of Monte Rosa, 4560 metres above sea level, for the study of life at high altitudes, and the results of his prolonged and arduous labours he published in his "Life of Man on the High Alps," which was translated into English in 1898. As human beings cannot live much more than two months at a time in these altitudes, he had a fully-equipped laboratory erected on Cold'olen at 3000 metres, where much physiological, physical, and biological work was done.

In his "Diagnostik des Pulses" (1879) he made a careful study of the pulse, and in 1895 he invented his sphygmo-manometer for the study of the blood pressure in man. Amongst the most interesting of his studies on the circulation are those on that of the brain. The temperature and psychical activities of this organ he studied in 1894, and the researches formed part of the subject of his Croonian lectures in 1892.

Perhaps his work best known in this country is that on fatigue—translated into French, German, and English—as studied by the use of his ergograph, a most valuable contribution, written with a charm of diction that one rarely finds in physiological memoirs. Mosso was a master of style, happy in his phraseology, wide and catholic in his literal tastes, a keen and loyal admirer of the poets of his beloved Italy. The bust of Dante was always present on his laboratory writing-table. His interesting work on "La Paura" ("Fear") was also translated into English. Amongst his other popular writings are "L'Education physique de la jeunesse," "Les Exercises physiques et le développement intellectuel," and "Materialismo et Misticismo."

Amongst his chemical investigations the best known are those on ptomaines (with Guaresche, in 1882), and the discovery of the fluorescent serum and the powerful toxic venin—which he called ichthyotoxin—which occurs in the blood of the Murinideæ, such as the conger eel.

In Angelo Mosso the world loses a great and distinguished physiologist, who was beloved by all who knew him, was venerated by his pupils, and by his work, both in its theoretical and its practical applications, secured for himself a reputation as an investigator and expositor such as to place him alongside that illustrious galaxy of his countrymen who have added so much to the domain of natural knowledge.

JULES TANNERY.

THE unexpected death of M. Jules Tannery on November 11, at the age of seventy-two, will be sincerely regretted by a much larger circle of admirers than he would have anticipated. He belonged to a type of mathematician which is not too common, because he was at the same time an original thinker, a successful teacher, and a writer endowed with an unusually clear, brilliant, and attractive style.

In England, at any rate, he is probably best known by his mathematical text-books. Of these, the "Leçons sur l'Arithmétique" is a masterpiece in its way, combining rigour of method with a charming lucidity and ease; the "Traité sur la théorie des fonctions elliptiques" (written in conjunction with M. Molk), is one of the best works on the subject suited for a beginner; while the value of his "Introduction à la théorie des fonctions" is shown by the fact that a second and revised edition has recently appeared. Tannery was essentially an arithmetician, and one main object of his work on function-theory is to show that (as Dirichht asserted) all its results are deducible from the notion of a whole number. A more philosophical work, dealing with the same class of ideas, is his "Rôle du nombre dans les sciences," which he appears to have regarded as his greatest work. As might be expected, he took a part in the controversies aroused by Cantor's invention of transfinite numbers.

M. Picard, in announcing the death of their colleague to the Academy of Sciences, referred in appreciative terms to the notices of mathematical works and memoirs contributed by Tannery to the *Bulletin des Sciences mathématiques*. He said:—"Elles ne sont pas toutes signées, mais on ne peut s'y tromper, car elles portent sa marque si personnelle. En les réunissant, on aurait un tableau fidèle d'une partie importante du mouvement mathématique dans ces vingt-cinq dernières années."

Tannery's last official post was that of vice-principal of the Higher Normal School, and he was elected an Academician in 1907. M. Picard bears witness to his amiable, witty, and engaging character in private life.

G. B. M.

NOTES.

SIR J. J. THOMSON, F.R.S., has been elected a corresponding member of the Berlin Academy of Sciences.

THE principal trustees of the British Museum have appointed Mr. Walter Campbell Smith, of Corpus Christi College, Cambridge, to an assistantship in the mineral department.

PROF. E. P. DI SESSA (Rome), Prof. E. G. Warburg (Charlottenburg), Prof. J. H. Poincaré (Paris), Prof. Alexander Graham Bell (Washington), and Prof. P. N. Lebedew (Moscow), have been elected honorary members of the Royal Institution.

THE sixth annual exhibition of electrical, optical, and other physical apparatus, arranged by the Physical Society, will be held at the Imperial College of Science, Imperial Institute Road, South Kensington, on Tuesday, December 20.

AT the request of the council of the Royal Society of Arts, Sir Edward Grey, Secretary of State for Foreign Affairs, authorised the transmission of the society's Albert medal to his Majesty's Ambassador at Paris for its presentation to Madame Curie. Sir Francis Bertie received Madame Curie at the British Embassy on November 25, and handed to her the Albert medal, telling her that he had been instructed by the Secretary of State to present it to her on the part of the Royal Society of Arts in recognition of the services rendered to the world by her discovery of radium, and adding that it gave him great pleasure to be the medium of carrying out the wishes of the society.

IN view of the candidature of Madame Curie for membership of the Paris Academy of Sciences, great interest attaches to the discussion at the last monthly meeting of the central administrative committee of the five French academies, on the admission of women as members of the Institut de France. According to the Paris correspondent of the *Times*, the committee was unable to agree, and it was decided, finally, that the question should be remitted to the administrative committees of the various academies, that their decisions should be considered at the next sitting on December 28, and that the whole question should be then transferred to the plenary trimestral united sitting of all the academies on January 4. It may be mentioned here that Madame Curie has just been elected an honorary foreign member of the Stockholm Academy of Sciences.

THE Vienna correspondent of the *Times* states that Mr. Alton, of the Radium Institute in London, has bought from the Austrian Ministry of Works, on behalf of Sir Ernest Cassel, 1 gram of radium for the sum of nearly 15,000*l.* The radium is a gift by Sir Ernest Cassel to the institute, and is intended for use in cancer research. One half of the gram is now being tested at the Vienna Radium Institute, and will be sent to England next month. The other half is being extracted from the pitchblende at Joachimsthal, and will be available in three or four months. Mr. J. W. Gifford, of Chard, Somerset, has announced to Prince Alexander of Teck, chairman of the Weekly Board of the Middlesex Hospital, his intention of presenting 40 milligrams of radium to the cancer research laboratories of that institution for the prosecution of their investigations. At current rates this quantity of radium, weighing approximately one seven-hundredth of an ounce, is worth about 600*l.*

THE following are among the lecture arrangements at the Royal Institution before Easter:—Prof. Silvanus P. Thompson, a Christmas course of six illustrated lectures on sound, musical and non-musical, a course of experimental acoustics, adapted to a juvenile auditory; Prof. F. W. Mott, six lectures on heredity; Dr. A. E. H. Tutton, three lectures on crystalline structure: mineral, chemical, and liquid; Dr. M. Aurel Stein, three lectures on explorations of desert sites in Central Asia; the Astronomer Royal, Mr. F. W. Dyson, three lectures on recent progress in astronomy; Dr. P. Chalmers Mitchell, three lectures on problems of animals in captivity; Prof. Arthur Keith, two lectures on giants and pygmies; Prof. W. A. Bone, two lectures on surface combustion and its industrial applications; Sir J. J. Thomson, six lectures on radiant energy and matter. The Friday evening meetings will commence on January 20, when Sir James Dewar will deliver a discourse on chemical change at low temperatures. Succeeding discourses will probably be given by Prof. W. H. Bragg, Mr. A. E. Shipley, Prof. H. E. Armstrong, Prof. Jean Perrin, Prof. Karl Pearson, Mr. J. H. Balfour-Browne, Sir David Gill, Prof. H. S. Hele-Shaw, Sir J. J. Thomson, and other gentlemen.

AN important question with regard to the distribution and occurrence of the various species of tsetse-flies in Africa is to what extent the areas infested by them remain constant. It has long been known that in a given tract of country certain parts harbour tsetse-flies, while from other parts they are absent; but of late years an impression has grown up that these areas are liable to change, and that the fly is spreading. Sir Alfred Sharpe, in a memoir on the habits of *Glossina morsitans* in Nyasaland (Bulletin of Entomological Research, vol. i., part iii.), is of opinion that fly-areas do not alter their limits to any appreciable extent. He states, however, that within the area, fly may sometimes be found in one part, sometimes in another, and in very variable quantity at different times. He believes that the numbers of the fly depend largely on the season of the year, but also on other causes impossible as yet to define. On the other hand, Mr. P. E. Hall communicates to the same journal some notes on the movements of *G. morsitans* in N.E. Rhodesia, and indicates on a map a number of areas which, to the best of his knowledge, were clear of fly up to 1906, but are now fly-infested. This conflict of opinion (perhaps more apparent than real) shows how urgent is the need of systematic investigations by expert entomologists upon these and other questions relating to the bionomics of tsetse-flies.

IN the *Philippine Journal of Science* for June Dr. R. B. Bean, of the Anatomical Laboratory, Manila, reports the discovery of a living specimen in the island of Luzon which he believes to bear close relationship to the Palæolithic type represented by the Neanderthal skull. The massive lower jaw with its square ramus and receding chin, the low cephalic index (73·68), heavy brow ridges, rounded orbits, large nasal apertures and high nasal index (102·2), combined with small stature (156·8 cm.), muscular frame and short femur, all approximate to a form similar to that of the antediluvian man of Europe, *Homo heidelbergensis*. Dr. Bean in the same issue of the Journal continues his study of the racial anatomy of the people of Taytay, dealing here with the women, whom he finds to be more primitive than the men, and closely resembling the women of Siberia. The Blend type is largely primitive in character, and the Austroloid variety comes between the Iberian and the primitive.

IN the first part of the Journal of the Royal Anthropological Institute Mr. W. Crooke discusses the origin of the Rajputs and Mahrattas, the warrior tribes of India. He identifies among the former a considerable intermixture of Central Asian blood derived from the Hun invasions, and he holds that they constitute a status group developed from a stock of which the lower grades are now represented by the Jats and Gujars of the Punjab. The Mahrattas he also considers to be a status group developed from the Kunbi tribe, and now claiming affinity with the Rajputs. He questions the validity of the suggestion that the brachycephalic element in southern India is the result of emigration of Huns or Scythians under pressure from the Aryans. It may be more reasonably accounted for by a prehistoric movement of races from the west either by the land route or in the course of commerce which existed with the Euphrates valley from a very early period.

OUR note in NATURE of November 24 (p. 114) upon the suggested inversion of the expression "thunder and lightning" leads another correspondent to point out that the phrase "animals and birds," inadvertently used on the same page, is open to the objection that it suggests that birds are not animals. He proposes the term "beasts, birds and fishes" as comprehensive and sufficiently distinctive.

DR. R. HORST has favoured us with a copy of an account of a new species of peripatus (*Paraperipatus lorentzi*) from Dutch New Guinea, published in vol. xxxii. (pp. 217–8) of Notes from the Leyden Museum. The species, which is fortunately represented by a male and a female, is of interest as filling a gap in the distribution of the group. The two specimens were discovered in moss on Mount Wichmann, at a height of between 9000 and 10,000 feet. In colour the new species is dark greenish-blue, becoming somewhat paler on the under side, and with a median central row of small whitish spots.

WHEN Dr. J. Huber succeeded Prof. E. A. Goeldi as director of the Museu Goeldi (Museu Paraense) in March, 1907, the opportunity was taken of reorganising the staff of that institution on a new and improved footing. These changes, as well as the general progress of the museum, are recorded in the reports for 1907 and 1908, which form the first portion of vol. vi. of the *Boletim do Museu Goeldi*, which, although relating to the year 1909, has only just been published. The zoological gardens attached to the museum, which are largely devoted to the exhibition of the animals of the country, appear to be in a thriving condition, having received a large number of accessions during the period under review.

THE pharyngeal teeth of fishes form the subject of an article, by Colonel C. E. Shepherd, in the November number of the *Zoologist*. These organs, except in the case of the wrasse and carp groups, have, according to the author, received but scant attention at the hands of naturalists. After referring to their different structural types, Colonel Shepherd expresses the opinion that pharyngeal teeth are probably the chief masticating organs, as they are undoubtedly in carp and wrasse. Fish-eating species, which swallow their prey whole, would have the action of the gastric juice facilitated if the bodies of the fishes swallowed had the scaly coat broken by means of the pharyngeal teeth. These teeth also assist in working the food down into the œsophagus.

THE local pearl and pearl-shell fishery forms the subject of an article by Mr. A. Seale in the July number (vol. v., No. 2) of the *Philippine Journal of Science*. Two species of pearl-oyster are found in Philippine waters, the valuable gold-lip, *Margaritifera maxima*, and the less precious black-lip, *M. margaritifera*. With the exception of those used in a factory at Manila, which is capable of turning out about 6000 gross of buttons per month, and consumes about 300 tons per annum, all the shells are exported to Singapore or Europe. Although almost the whole area from Sibutu Passage to Basilan Strait and the south shore of Mendanao is a potential pearl-bank; most of the banks have been over-fished, and it is now difficult to find productive ones. One bank was recently found in which all the shells were dead, and so corroded as to be valueless. The fisheries afford a fair yield of pearls, although much less than the Ceylon output, which comes from a smaller species, with shells of little value. On the other hand, some of the finest known pearls are the product of the Sulu fishery. The Japanese are producing pearls, although not of good shape, by introducing foreign objects into the oysters, and the author states that within the next few years it will be possible to produce perfectly spherical pearls of good lustre.

TO the Proceedings of the U.S. National Museum, No. 1778, Messrs. Everman and Latimer communicate the first complete list of the fishes of the Lake of the Woods and neighbouring waters, so far as at present known. Although the Lake of the Woods, which forms the receptacle for the waters of Rainy River, lies mainly in Ontario, its southern border is situated on the northern frontier of Minnesota, and therefore belongs to the United States. On account of the recent treaty between Great Britain and the United States, which provides for the federal control of the fisheries in these waters, an account of their fish-fauna is a matter of some importance at the present time. The fisheries in the Lake of the Woods, which are carried on by means of nets, are of very large economical value, having yielded in 1909 a total sum of 42,193 dollars, of which 28,051 pertained to the United States and 14,142 to Canada. In 1894 the total value was, however, as much as 81,337 dollars. The most valuable product is the great lakes sturgeon (*Acipenser rubicundus*), which formerly swarmed in Lake of the Woods, and in 1893 yielded no fewer than 26,000 dollars, although of late, like that of the rest of the fishery, the yield has been much less. During the last few years a slight increase in the catch is, however, reported, but this may be due to closer fishing.

IN connection with the preservation of localities where rare plants or special plant associations are found, attention is directed to a paper, by Mr. A. R. Horwood, on the extinction of cryptogamic plants, published in the Transactions of the South-Eastern Union of Scientific Societies (1910). The author discusses the numerous factors that lead to the extinction of plants, and presents the results of special inquiry with regard to Ireland, where perhaps the most destructive factor is the collector, who in the south-west counties raids the ferns *Trichomanes radicans* and *Osmunda regalis*.

IN the *Victorian Naturalist* (vol. xxvii., No. 6) is published a report by Mr. J. W. Audas on a botanical expedition in the Victorian Alps, and a list of plants recorded from the district that has been compiled by Dr. A. J. Ewart. Out of 334 species, one-third belong to the three families Compositæ, Leguminosæ, and Myrtaceæ, while the families Saxifragaceæ and Ericaceæ are only represented by *Bauera rubiginosa* and *Gaultheria hispida*; a single gentian, *Gentiana saxosa*, is found. The one endemic plant is a bushy labiate, *Westringia senifolia*.

Among the plants observed by Mr. Audas about an altitude of 5000 feet were the shrubs *Eriostemon myoporoides*, *Helichrysum rosmarinifolium*, and *Kunzea Muelleri*; near the summit of Mt. Hotham he found the grass-like umbellifer, *Aciphylla glacialis*, and a tufted carophyll, *Scleranthus biflorus*.

MR. E. P. STEBBING presents in Forest Pamphlet No. 15, published by the Government of India, a note on the preservation of bamboos from the attacks of the bamboo beetle or "shot-borer." The destructiveness of this insect, *Dinoderus minutus*, may be gauged from the fact that bamboos generally last in India only for a year or eighteen months. Cooperation between the author and the Indian Telegraph Department has resulted in the evolution of an effectual method of treatment, which consists in soaking the bamboos for five days in water, when they exude a gelatinous substance, and then immersing in Rangoon oil for forty-eight hours. The object of the bulletin is to record the experiments undertaken and the results, showing that the oil has effectually preserved bamboos treated in 1904 up to the time of writing in 1909.

THE *Agricultural Journal of British East Africa*, recently to hand (vol. iii., part i.), contains a short article by Dr. Bodeker on native methods of fishing in relation to the incidence and dissemination of sleeping sickness. Fishing is attended with grave danger to all natives in the vicinity wherever *Glossina palpalis* is found. Several districts where formerly a large population of fishermen dwelt are now uninhabited as a result of the disease. Among remedial measures, the destruction of the thin strip of bamboo canes along the whole coast-line is recommended. In another article Mr. MacDonald urges the advantages of maize as a crop for export. It can be grown readily and at comparatively low cost over a large area of the country, and, so far, it has not been infested by any seriously destructive pest. Railway rates to the coast being now much reduced, it becomes possible to send the maize to Great Britain or to the Continent, where the demand is practically unlimited.

A TABLE is given in a recent issue of the *Journal of Agriculture of South Australia* (vol. xiv., No. 1) showing how the use of fertilisers for cereals has increased during the past thirteen years. From 1898, the first year given in the table, to the current year the increase has been continuous; some of the figures are as follows:—

Year	Quantity of manure used Tons	Area of cereal crop manured Acres
1898	12,500	250,000
1899	16,500	350,000
1907	61,000	1 366,400
1908	65,000	1,456,000
1909	76,500	2,100 000
1910	87,000	2,320,000

A few soil analyses are recorded in another article, from which it appears that the soils are very different from our own. The nitrogen varied from 0·026 to 0·091 per cent., the phosphoric acid from 0·010 to 0·045 per cent., and the potash from 0·044 to 0·82 per cent. All these values are much lower than in ordinary English arable soils.

THE Natal Museum has issued a catalogue of a collection of rocks and minerals from Natal and Zululand arranged stratigraphically by Dr. F. H. Hatch. The specimens were collected by Dr. Hatch during the winter months of 1909. Beginning with the oldest rocks, the order of arrangement is:—(1) metamorphic rocks, Swaziland system; (2) granites intrusive in the metamorphic rocks of the Swaziland system; (3) Waterberg or Table Mountain sandstone; (4) rocks of the Karroo system; (5) surface deposits. The collection of specimens is a duplicate of one which Dr. Hatch proposes to present to a London museum.

IN a paragraph upon the recently discovered ice-cave near Obertraun, Upper Austria, which appeared in NATURE of October 13 (p. 469), Prof. E. Fugger was described as one of the explorers of the cave. Prof. Fugger asks us to state that he has not yet personally examined the cave, and that the information he kindly sent at our request was provided by Herr Alexander von Mörk, who took part in the exploration of it. The discoverers and first explorers of the cave were, according to reports in the Linz newspapers, Herren J. Lahner and Kling (Linz), J. Pollak (Wels), I. Bock (Graz), A. v. Mörk (Salzburg), and L. Kranl (Budapest).

MESSRS. OUTES AND BÜCKING have added notably to the discussion of the *tierras cocidas* of the Pampas beds of Argentina by publishing photographs of thin sections of the debatable materials ("Sur la structure des scories et 'terres cuites,'" *Revista del Museo de la Plata*, vol. xvii., p. 78, September). Scoriæ are figured from Monte Hermoso which are undoubtedly of volcanic origin. These are contrasted with the fragmental earths, which contain, however, volcanic particles. When these earths are subjected to the action of fire, they show fluidal structures and a glassy ground between the surviving fragments, and certainly do not resemble the alleged "terres cuites" selected for comparison. True burnt earths are formed during agricultural operations near La Plata when the settlers wish to clear their ground by burning the surface-vegetation, and these are of the glassy type. It is urged, therefore, that the andesitic scoriæ which occur in the earths of the Pampas beds cannot be regarded as products of superficial burning. The petrographic argument is immensely strengthened by the illustrations, and their production, if we may judge from a quotation made by the authors, seems due to certain remarks published in NATURE in 1909 (vol. lxxxi., p. 535).

IN the September Bulletin of the American Geographical Society, under the title of "Notes on the Description of Land Forms.—I.," Prof. W. M. Davis returns to his attack on the "empirical" method of description in a criticism of three recent geographical papers (German, Italian, and English). He urges that it is "ultra-conservative" to adhere to the empirical method when "the whole trend of modern physical geography is toward the use of explanatory description." It may be replied, however, that while the new "terms of origin" can be sometimes used with good effect by a physiographer of Prof. Davis's experience and confidence, they might be more misleading than any empirical description if employed wrongly or applied without sufficient warrant. It is not every traveller who could be trusted with the use of "mature insequent ravines," &c., as desired by Prof. Davis in his "Notes."

THE November issue of the *National Geographic Magazine* contains thirty-nine photographs in colour, which is the largest number of coloured pictures ever published in a single number of the magazine. These illustrations all deal with life and scenes in Korea and China, and together provide an excellent means of picturing the habits and customs of these Eastern peoples. The article which is illustrated by these pictures is by Mr. William W. Chaplin, who shows an intimate acquaintance with the countries he describes, and he also took the photographs

from which the pictures were made. Mr. Guy E. Mitchell contributes a well-illustrated paper on a "New Source of Power," in which he deals with the extensive beds of lignite in the United States. The State geologists have estimated that the lignite deposits in the United States, exclusive of Alaska, amount to 740×10^9 tons, of which fully one-third belongs to the public lands. The total area underlain by lignite and sub-bituminous coal—coal mostly of little, if any, value in steam plants, but of great efficiency in gas producers—is 246,245 square miles. The U.S. Geological Survey fuel tests have showed that when coal is made into producer gas and then used in a gas engine, it has from two to three times the efficiency that it has when burned under a steam boiler in the ordinary way. Moreover, the experiments showed that lignite, which is useless for steaming purposes, can be used most successfully in the gas producer. Other articles in this issue of the magazine are "Kboo, a Liberian Game," by Mr. G. N. Collins; the "Pest of English Sparrows," by Mr. N. Dearborn; and "The Mistletoe," by Mr. W. L. Bray.

The remarkable series of earthquakes that occurred in Alaska in September, 1899, is described in a valuable paper by Mr. Lawrence Martin (Bulletin of the Geol. Soc. of America, vol. xxi., 1910, pp. 339–406). The first known shock occurred on September 3, the last on September 29. In these four weeks there were four, possibly five, world-shaking earthquakes, and several hundred minor shocks. The strongest of all was the second great shock of September 10. It disturbed an area of probably not fewer than 432,000 square miles, and produced water-waves in Lake Chelan, Washington, which is nearly 1200 miles from the origin. Shore-lines were raised as much as $47\frac{1}{3}$ feet, and depressed 5 feet or more in Yakutat Bay, and new reefs were uplifted. Sea-waves 20 or 30 feet high swept the shores. The Muir Glacier subsequently retreated eight miles in as many years, while other glaciers were subject to brief spasmodic advances. But, though the earthquake ranks among the greatest that have visited the American continent, there was no recorded loss of life among the twenty thousand inhabitants of the disturbed area, while the destruction of property was insignificant. This immunity was, no doubt, due to the fact that the people lived in tents, log cabins, or low frame buildings.

In *Bergens Museums Skrifter. Ny Raekke.*, Bd. i., No. 1, Dr. A. Appellöf, of the Bergen Museum, describes the investigations on the life-history of the common lobster, upon which he has for a number of years been engaged. The monograph ("Untersuchungen über den Hummer") contains also a summary of previous work on the subject, and, as a whole, gives the best account of our knowledge of the natural history of the lobster which is at present available. With regard to the migrations of the animal, Dr. Appellöf, basing his opinion chiefly on the results of marking experiments, concludes that the lobster is a stationary animal, and remains in a very restricted area for many years, undertaking only short migrations, a conclusion which is of great importance when possible schemes for stocking a fishery by means of artificial rearing of lobster larvæ are under consideration. The author considers that the probability of increasing the supply of lobsters on the fishing grounds by means of artificial hatching, combined with the rearing of the larvæ until they reach the bottom-haunting stages, is very great, and refers to the successful rearing experiments carried out by Mead in the United States. The monograph is illustrated by a series of plates showing the various stages of development of lobster larvæ.

We have received from Mr. A. Ghose a letter with reference to the review in Nature of September 29 (p. 406) of his paper on "Manganese-ore Deposits of the Sandur State." Mr. Ghose points out that the Indian outputs of manganese ore were quoted incorrectly; our reviewer regrets the error, and supplies the correct figures as follows:—Production of manganese ore in the State of Sandur during 1908, 23,413 tons; during the quinquennial period 1904–8 (four years), 50,872 tons. Production of manganese ore in the Presidency of Madras during 1908, 118,089 tons; in the quinquennial period 1904–8, 513,845 tons. Production of manganese ore in the whole of India during 1908, 685,135 tons; in the quinquennial period 1904–8, 2,545,718 tons. The production of Sandur is therefore a little more than 3 per cent. of the whole output of India.

The meteorological chart of the North Atlantic for December (first issue), published by the Meteorological Committee, has some interesting details of the two West India hurricanes experienced during October last. A cablegram from Havana on October 13 stated that the barometer was then falling, and later on a destructive cyclone passed over the south of Cuba, and was central between there and Cay West on October 15. On October 17 another storm of greater intensity (referred to in London newspapers on October 19) passed over Havana, and the island of Cuba is reported to have sustained the greatest material damage in its history. Several steamships were driven ashore by one or other of these hurricanes. Interesting synoptic weather charts are also given for the period November 10–16. These and the useful explanatory text indicate the existence of three high-pressure areas, one over the western American States, another to the north of Iceland, and a third which was gradually transferred from Europe to the region of the Azores. Over Europe as a whole the weather was dominated by depressions developed over the upper portion of the Atlantic, between the Icelandic and Azores high-pressure systems.

We have received from the Abbé T. Moreux, director of the Bourges Observatory (Cher), a revised edition of his pamphlet entitled "Introduction to the Meteorology of the Future: the Sun and the Prediction of Weather." The Abbé is dissatisfied with the present method of forecasting weather for a day or two in advance. He points to the changes in the sun, which seem to have some connection with those on the earth, and asks whether this is not something more than a simple coincidence. He quotes step by step the progress made in tracing this connection from the time that Sir W. Herschel discussed the question of sun-spots (Phil. Trans., 1801, p. 265), and rapidly passes in review the labours of Schwabe, Wolf, and subsequent investigators down to the present day, and many references are given to the discussions which have appeared in our columns and elsewhere. The spectroscopic researches and discoveries of Sir Norman Lockyer and M. Janssen, and the establishment of the Solar Physics Observatory at South Kensington, are referred to as of prime importance; the former marked the epoch of extended observations on the simultaneity of solar and terrestrial changes, and the latter formed a base for similar inquiries in other parts of the world. The author observes that we have now an important groundwork of operations, and it must be maintained at any price.

In two notes published in the *Bulletin International* of the Academy of Sciences of Cracow (March and April) Dr. Const. Zakrzewski communicates the results of measurements made by him on the dispersion of metallic

bodies in the visible spectrum. Two experimental methods were used:—(1) The author's "elliptic analyser," described by Dr. Zakrzewski in 1907, and used since with success by Herr Volke; as shown in the paper, this arrangement provides a comparatively exact way for the determination of the refractive index ν and of the index of extinction κ for a metallic body. (2) A new scheme depending on the use, for the observation of ellipticity, of a convergent pencil of light; the results thus obtained are estimated to be correct within 5 per cent. of their values. Illustrative results for platinum, cobalt, and graphite are adduced. Maxwell's simple equation $\nu^2 - \kappa^2 = \text{const.}$, now given up on theoretical grounds, is found to hold true for graphite. The second correlative equation, however, asserting the proportionality of the product $\nu\kappa$ with the period of vibration in the incident beam of light, does not agree with the observations.

An interesting address on "Comets and Electrons" was delivered by Prof. Augusto Righi to the Bologna Academy on June 22, and is published as No. 13 of *Attualità scientifiche* (Bologna: Nicola Zanichelli, 1910, price 2.50 lire). In the paper Prof. Righi traces the growth and development of ideas regarding radiation-pressure, the successive proofs, disproofs, and reproofs of its existence for finite bodies, for minute solid particles such as are believed to exist in comets' tails, and for gaseous molecules, the theory of formation of the tails themselves, the electrical phenomena accompanying them, the escape of gases from planetary atmospheres, the nature of sun-spots and allied astrophysical phenomena. Prof. Righi, in conclusion, refers to the experiments conducted during the passage of the earth through Halley's comet, a large proportion of which gave rise to no definite conclusions. The following suggestive remark occurs in the paper:—"In this connection of the action of radiations on the individual molecules of a gas, and hence on the presence of gases in comets' tails, there has been once more verified the not uncommon fact that conclusions which are just, or regarded as such, are reached only by an asymptotic method, that is, after a series of successive corrections, and often, as in the present case, after having completed a series of successive oscillations, fortunately of decreasing amplitude, from one side to the other of the truth."

A committee was appointed about two years ago by the Institution of Civil Engineers to investigate and report on questions connected with the use of reinforced concrete. A preliminary and interim report has now been issued giving information regarding the conditions under which reinforced concrete has been employed in engineering work in various countries, and the views of engineers having special experience in its use. The committee does not accept any responsibility for any of the statements contained in the report, and reserves its own views and recommendations until later. Hence the designer will still have to depend largely on the excellent report presented some time ago by the Royal Institution of British Architects, more especially as he will find difficulty in extracting definite information from the present report. The reader is expected to compare for himself the various statements of opinions contained in 262 pages of letterpress. The committee is now engaged upon tests and investigations in order to enlarge the knowledge at present available, and no doubt more definite information and conclusions will appear in a subsequent report.

Messrs. Newton and Co. have been granted a warrant of appointment as opticians to the King. They have held Royal warrants for more than sixty years.

OUR ASTRONOMICAL COLUMN.

Ephemeris for Faye's Comet, 1910*e*.—Dr. Ebell publishes a continuation of the ephemeris for Faye's comet in No. 4457 of the *Astronomische Nachrichten*; the following is an extract:—

Ephemeris 12h. (Berlin M.T.).

1910	α (true) h. m.	δ (true) ° ′	log *r*	log Δ	mag.
Dec. 6	3 37·1	+3 44·0	0·2270	9·8717	10·3
,, 10	3 37·6	+3 25·0	0·2292	9·8845	10·3
,, 14	3 38·5	+3 12·8	0·2316	9·8985	10·4
,, 18	3 39·8	+3 7·1	0·2342	9·9134	10·5
,, 22	3 41·6	+3 7·5	0·2371	9·9290	10·6
,, 26	3 43·7	+3 13·3	0·2401	9·9453	10·7
,, 30	3 46·3	+3 24·1	0·2433	9·9621	10·8

This ephemeris is calculated from Prof. Stromgren's elements with a correction ΔM., and the time of perihelion is brought forward by about +8·91 days, to November 1·647 (Berlin M.T.); an observation at Teramo on November 23·4 gave a correction of −9s., −2·1′, to the ephemeris position.

Recent Helwan Photographs of Halley's Comet.—Halley's comet was again photographed with the Reynold's reflector at the Helwan Observatory on November 7, 9, and 11, and the plates indicate a correction of +0·2m., 0′, to the ephemeris published in No. 4450 of the *Astronomische Nachrichten*; the magnitude is estimated at about 14·5.

A telegram from Prof. Frost announces that Prof. Barnard observed the comet (presumably with the 40-inch refractor) at the Yerkes Observatory on November 11 at 17h. 17·8m. (M.T. Yerkes), and found its magnitude to be about 11·0; the observed position was

R.A. = 12h. 4m. 21·3s., dec. = −14° 54′ 15″.

From these observations it would appear that there is a marked difference between the photographic and visual magnitudes, and, curiously enough, it seems that the visual brightness is the greater (*Astronomische Nachrichten*, No. 4457).

The Total Eclipse of the Moon on November 16.—Some interesting notes dealing with observations made during the recent eclipse of the moon appear in No. 21 of the *Comptes rendus* (November 21). MM. Luizet, Guillaume and Merlin, at the Lyons Observatory, observed the occultations of several stars, and found that in some cases the disappearances were not instantaneous. In two cases the star appeared to be projected on the disc before disappearing, and in one case contact with the limb preceded disappearance by three seconds. On the other hand several well-observed occultations and reappearances were quite sudden.

M. Montangerand, Toulouse Observatory, noted that in one case the extinction took an appreciable time, but in two others it was instantaneous; he also directs attention to the apparent unevenness of the shaded disc. M. Lebeuf, at Besançon, also noted this phenomenon, and describes the apparent rotation of the deeper coloration as the eclipse proceeded. The general transparency of the shadow, as compared with earlier eclipses, notably that of April 11, 1903, also attracted his attention.

M. Jonckheere, at the Hem Observatory, was able to see the penumbral shadow, with the naked eye, at 10h. 32m., and observed first contact with the shadow at 10h. 57m. 5s. (M.T. Hem). He also records that the meteorological observations, presumably delicate, indicated a sensible lowering of temperature during totality.

The Probable Errors of Radial-velocity Determinations.—The radial velocities of stars are now being measured by many observers, not always with concordant results, and it becomes important that the probable errors of such observations should be investigated and defined with every care. In a paper in No. 3, vol. xxxii., of the *Astrophysical Journal* (p. 230), Mr. Plaskett deals with this subject, basing his discussion on exhaustive experiments he has made at the Ottawa Observatory. Many factors enter the problem, and one of the most important is the effect of dispersion. Mr. Plaskett finds that, contrary to expectation, the accuracy is not inversely proportional to the dispersion of the spectrograph used, only a

small increase of probable error, say 40 per cent., appearing when the dispersion is divided by three.

In the early-type stars the diffuseness of the available lines in the spectrum increases the probable error very rapidly, and Mr. Plaskett is convinced that physical causes in the star's atmosphere are contributory to this increase.

For solar-type stars it would appear that the average probable error of a good three-prism determination need not exceed ± 0.5 km. per sec., while with one prism ± 0.70 km. might be expected in good work. If stars of an earlier-type spectrum are dealt with, ± 2 to ± 11 km. per sec. is a moderate estimate of the probable error. Finally, Mr. Plaskett suggests that with solar stars the greater part of the error accrues from instrumental causes, the errors of measurement only accounting for about one-third or less.

THE PHOTOGRAPHIC MAGNITUDES OF STARS.—In Circular No. 160 of the Harvard College Observatory Prof. E. C. Pickering discusses the progress made, to July, in the establishment of a method for determining photographic magnitudes and of a scale for recording them.

Three methods have been found to give satisfactory results. The first depends upon the law that stars of the same spectral class have the same colour and has been tested with concordant results; the following values are interesting as giving the constants necessary to reduce photometric to photographic magnitudes according to spectral class:—

B	A	F	G	K	M
−0·31	0·00	+0·32	+0·71	+1·17	+1·68

Thus if the visual magnitude of a star is 5·00 and the spectrum is of type B, the photographic magnitude is 4·69, but if the spectrum is of the G type the photographic magnitude is 5·71.

The second method, in which a standard "polar sequence" of stars is photographed on the same plate and under similar conditions as the stars to be measured, has been already described in these columns, but it is interesting to note that the work has been extended to stars so faint as the twentieth magnitude, and it is hoped, ere long, to publish definitive magnitudes for a great number of stars in both hemispheres. About 11,000 measures of 200 photographs have already been made; for stars fainter than magnitude 14, for which long exposures are necessary, it has been found that this method is not so suitable. For such stars it has been found that the third method, in which a small circular prism of very small angle is attached to the centre of the objective, is better; the small prism diverts a known proportion of the light from each image into a secondary image, and so provides a ratio scale. Prof. Pickering discusses the difficulties presented by the problem, and states that although the results already attained are very hopeful, much remains yet to be done.

The same problem is also attacked by Herr E. Hertzsprung in No. 4452 of the *Astronomische Nachrichten*, who proposes a tried method in which the density of a direct image is compared with an image, on the same plate, produced when a grating is placed before the objective.

PROPER MOTION OF THE STAR B.D.+33° 99.—Whilst making observations of the minor planet 1910 KU, Dr. Abetti was led to suspect that one of his comparison stars, B.D.+33° 99 (AG. Lei. 226), has a large proper motion. Subsequent investigation and calculations show that this proper motion amounts to $-0{\cdot}027 \pm 0{\cdot}004$s. and $-0{\cdot}34 \pm 0{\cdot}00''$. The magnitude of this star is 8·5 (*Astronomische Nachrichten*, No. 4453).

THE NEW METEOROLOGICAL OFFICE.

ON Thursday, December 1, a large party assembled at the new Meteorological Office at the corner of Exhibition Road and Imperial Institute Road on the invitation of the Meteorological Committee.

The committee was originally appointed by H.M. Treasury in 1905 to control the administration of the Parliamentary grant for meteorology. Its inexpressive title gives little indication of its responsibility to the country and, indirectly, to the world at large. It consists of the director of the office, Dr. W. N. Shaw, who is *ex officio* chairman; the hydrographer of the Navy, Rear-Admiral H. E. Purey Cust; Mr. G. L. Barstow, of the Treasury; Captain J. M. Harvey, of the Board of Trade; Mr. T. H. Middleton, of the Board of Agriculture and Fisheries; with Sir G. H. Darwin, F.R.S., and Prof. Arthur Schuster, F.R.S., the nominees of the Royal Society.

The work of the office goes back, in continuity, to the original establishment of a Meteorological Department of the Board of Trade for the joint service of the Navy and the mercantile marine under the superintendence of Admiral FitzRoy, the naval officer who, as captain of the *Beagle*, had carried Charles Darwin round the world. The motive power for the establishment of a special department for meteorology came from a maritime conference held in Brussels in 1853, in which Lieut. Maury, of the United States Navy, a well-known geographer and meteorologist, took a leading part. The primary object of the office was the collection and discussion on an organised plan of meteorological observations made at sea; but when Leverrier began collecting daily observations by telegraph in France, FitzRoy associated himself with the idea, and in 1860 he introduced a system of weather telegraphy with storm warnings and forecasts which in 1861 were published in the newspapers.

This line of action evoked a great deal of criticism on the part of scientific authorities, and it is doubtful whether meteorology, at that time a bashful *débutante* among the sciences, has ever been forgiven for so shocking a *faux pas*. It is true that the system of warnings was continued after FitzRoy's death at the instance of the Board of Trade, influenced by several memorials to Parliament, and that in 1879, after the issue of forecasts had been dutifully suppressed for twelve years, in a report of the council then in control of the office, appointed by the Royal Society and made up of the great names of Henry J. S. Smith, Warren De la Rue, Frederic J. O. Evans, Francis Galton, George Gabriel Stokes, and Richard Strachey, the following paragraph appears:—"For several years forecasts not intended for publication had been daily prepared in the office, and the experience thus gained by the staff has emboldened the council to announce their readiness to commence in April, 1879, the issue to the public of forecasts for the different parts of the United Kingdom," and that the issue has been continued ever since; but the natural hesitation which men of science feel about publishing their conclusions before they have had an opportunity of verifying them has always overshadowed that side of the office work. To that circumstance, combined with the frigidity with which the young science has been treated by her elder sisters, it is probably due that, while prolonged effort has been devoted to the preparation of forecasts twice, or even three times a day, for a whole generation, and while the rule that no forecast shall be formulated without first setting out the data and the grounds for the inference has been rigorously enforced, yet the issue of the forecasts has been left practically to the newspapers. It seems otherwise inexplicable that no general system of distribution of forecasts by telegraph should have been adopted in this country.

FitzRoy died in 1865, and the office became the subject of inquiry by a Government committee, with the result that in 1867 the control of the Parliamentary grant was handed over to a committee of the Royal Society, with Sir E. Sabine, the president of the Royal Society, as chairman. At the same time provision was made for marine meteorology and weather telegraphy to be associated with the work of fully equipped meteorological observatories of the first order, six of which were forthwith established, namely, Falmouth, Stonyhurst, Aberdeen, Glasgow, Armagh, and Valencia, in addition to Kew, which had become the central observatory of the system.

Continuity between FitzRoy's department and the Meteorological Office was maintained by the transfer of all the duties of the department and a number of members of the staff to the new committee. Mr. T. H. Babington, however, who took over the management of the department on FitzRoy's death, was not transferred; Mr. R. H. Scott was appointed director of the new establishment with

Captain H. Toynbee as marine superintendent. The office occupied the quarters at 1 and 2 Parliament Street, belonging to the Board of Trade, which accommodated FitzRoy's department; but to its chagrin it was dispossessed in 1869, and the ejected committee hired accommodation for itself in the form of a residential flat over a shop at 116 Victoria Street.

In 1875 another Government committee of inquiry was constituted, with the result that in 1877 the direction of the office became vested in a council appointed by the Royal Society. This constitution lasted until 1905, when, as the result of a third committee of inquiry, the present system was adopted, under which the office is managed by a director with an advisory committee appointed by the Treasury. Throughout the period of the council the office occupied the premises at 116 Victoria Street, which during its tenure was renumbered 63.

It cannot be said that the council regarded the suite of offices which they occupied as ideal accommodation for the Office; but it was generally hampered for want of funds, and, as a matter of practical politics, the idea of new accommodation may be attributed to Sir H. Maxwell's committee of 1903, which pronounced the accommodation at Victoria Street to be unsuitable. The advantage of housing the office under the same roof as a post office had long been recognised, and the wish of the Post Office to have a permanent structure at South Kensington on land which formed part of the estate of the Commission for the Exhibition of 1851 led, at the suggestion of a member of the Meteorological Committee, to an arrangement by the Treasury for the committee to rent from H.M. Office of Works more spacious accommodation than they had at Victoria Street at practically the same rent. The arrangement was concluded in May, 1907, and the transfer of the work to the new premises was completed on November 15, 1910. The party on December 1 was intended to give those interested in the work of the office an opportunity of seeing the new premises newly equipped.

This long introduction is necessary, because the office has now fifty-six years of history behind it, passed in a habitation chosen with a view to the collection and discussion of observations from sea and land. During that time it has been responsible for supplying meteorological instruments to the Navy, the mercantile marine, its own stations, and recently to colonial Governments, and it has become the controlling centre of more than 500 stations of various kinds in these islands and in various colonies, while it has instruments on more than 200 ships afloat, and is in direct communication with nearly all liners crossing the Atlantic. It has made a vast collection of observations from ships in the form of log books which fill 500 feet of shelving. It deals with about 50,000 telegrams a year in its telegraphic branch. The independent existence of the British Rainfall Organisation, founded as a private enterprise by Mr. G. J. Symons, a member of FitzRoy's staff, exonerates it from dealing fully with the statistics of rainfall, but for more than forty years it has aided the meteorological societies of London and Edinburgh in the collection of climatological data for the British Isles, and has gradually become itself a centre for the compilation of returns from volunteer observers all over the country and from some of the colonies. To this collection is added the published meteorological data of all the countries of the world, forming a library almost unique of its kind. It has issued publications to the number of about 250 volumes, which, being in the form of Bluebooks or of unwieldy atlases or charts, are little read. So far as the general public is concerned, it appeals to them only through the forecasts which the newspapers are kind enough to issue for it, through the storm signals which are occasionally visible on the coasts, and through certain fishery barometers supplied to coast stations, which are, however, mostly marked with the initials B.T., because the official in charge was unwilling to recognise as *de jure* the dissociation *de facto* of the office from the Board of Trade.

Until quite recently, partly on account of the apathetic attitude of the universities, partly because meteorology deals with British units and other sciences use metric units, the education of the people in the new science had not ever been begun. The meteorology of Daniell and Herschel had been, in fact, allowed to fall out of the educational curriculum, and its place was taken by sciences with which the teachers were themselves acquainted.

In moving their home from Victoria Street to South Kensington the Meteorological Committee has set itself to change all this. They have sought to secure, with what success the public may now judge, space in which their collection of books and records can be reasonably well housed, and which at the same time affords an opportunity to display, for the information of the public, a series of exhibits which show what the work of the Meteorological Office has been in the last fifty years, what its work is now, how it does it, and what its purpose is in doing it. Those who have visited the office will agree that the idea of combining a library with a museum has elicited very generous sympathy from the Office of Works, and that the architect of the new building, Sir H. Tanner, has dealt with the problem, which is not without difficulty, in a manner for which admiration is not too strong a term to use. The space is perhaps a little over full, as the library has even now to accommodate part of the working staff of the office in addition to its other requirements; but when it is remembered that rent is still a consideration to be reckoned with by the committee, there is, after all, little to complain of.

The office premises are mainly on the first and second floors of the new building at the corner of Exhibition Road and Imperial Institute Road. These two floors provide, besides the library and its ante-room, a room for the director and rooms for the four superintendents and for the director's secretary, a large room for the clerical staff and another for the forecast staff, three rooms for the marine staff, and two for the instruments staff. To judge by external appearances, the whole building might be regarded as a post office, but it is not so. The ground floor and the greater part of the basement is assigned to the post office, but in the basement the Meteorological Office has space which it is hoped may provide for a printing office as well as a workshop. A small physical laboratory is provided on the third floor, the remainder of which is temporarily occupied by the staff of the Science Museum. Access is given thereby to a large flat roof, which provides invaluable opportunity for the exposure of instruments for the purposes of trial and investigation.

The manner in which the committee have utilised the space at their disposal and have kept in view the educational purposes which have been indicated will be evident from the list of exhibits prepared for the party on December 1.

In a case outside the doorway is exhibited the most recent information about the current weather, based on the telegrams received. In the outer lobby, opposite the door of the post office, is a case containing a barograph, the recording apparatus of a Callendar thermograph, and of a Dines pressure-tube anemograph, exhibiting the continuous record of pressure, temperature, and wind velocity. On the walls of the inner lobby and the staircase leading to the first floor are a series of frames showing the course of the seasons in the British Isles as determined by the weekly averages since 1878. The relation thereto of the weekly values of the current season for four divisions of the country is shown upon transparent paper, which covers the diagrams of average variation. These diagrams lead up to one which shows how the meteorological elements at the several stations in the same district may vary under similar types of weather. Four frames show the monthly meteorological charts of the Atlantic and Indian Oceans, and further on is a diagram showing the variation of temperature in the upper air on various occasions in 1908 up to 15 miles or more, in juxtaposition with a series of photographs of clouds presented to the office by Dr. W. J. S. Lockyer.

The catalogue of exhibits makes reference to a series of three cases on the first-floor hall intended to illustrate the work of the office under FitzRoy at the Board of Trade, under Sabine and Scott, of the Meteorological Committee of the Royal Society, and under the Meteorological Council, with Smith and Strachey, successively, as chairman, but for reasons not given in the programme the cases are not yet there; some of the exhibits are to be found compressed into a single case in the upper corridor.

The hall accommodates, however, a radiation recorder by Callendar and a hyetograph or rain recorder of Negretti and Zambra's most recent pattern.

From the hall we pass to an ante-room provided with a counter for the supply of information of various kinds, and leading to the library and museum on the one side and to the headquarters of the clerical and inquiry staff on the other. This room, with the library and the staircase, are finished throughout with ornamental woodwork in Austrian oak. Round the ante-room are glass cases for the display of barograms from ships and land stations, anemograms and other records of importance to aëronauts, and also cases devoted for the present to diagrams prepared in the office to show results deduced from data for the whole globe or for British observatories or stations, including the relationships of meteorology and agriculture. A diagram, newly prepared, showing the distribution of rainfall throughout the day for the several months of the year at Kew and Valencia, is specially noticeable. In the same room is the Kelvin harmonic analyser constructed for the council to be used for the analysis of barograms and thermograms. A relief map of the British Isles on the scale of one-millionth, intended for the central space, being unfinished, was represented by a cast of the English section.

On either side of the entrance to the library and museum are square kiosks for envelopes, the faces of which are framed in glass and used for displaying the weekly sets of records from observatories, the records of sunshine at ninety-two stations for a single day of last summer, and the winter sunshine records of 1909–10 in London, Cambridge, and Eastbourne. Within the library, in four cases, are displayed a series of exhibits in connection with marine meteorology, the daily service of forecasts and storm-warnings, climatological statistics, and the investigation of the upper air. Another and larger case is devoted to the observatories at Kew and Eskdalemuir. Four small cases show a new method of representing data for the whole world on what is called a developable globe. The current daily weather charts of all countries and the latest climatological reports from the British Dominions are collected together in special cabinets. Two glass cases face one as one enters the museum: one contains specimens of the normal instruments adopted by the office, the other such examples as the office possesses of the corresponding instruments of other countries.

The library is divided into six compartments by bookcases extending from the side walls. In four of the compartments the books of published data are grouped according to countries, the remainder being occupied by periodicals, text-books, &c. The recesses of three of the bays are used by the working staff of the statistical and library division of the office; two are furnished with tables for students, and on the book-cabinets near by the latest additions to the library are displayed. A few educational exhibits, lantern-slides, photographs, &c., including some valuable stereophotographs of clouds from a long base, by Mr. J. Tennant, were set on Thursday on one of the tables.

The library is not large enough to contain all the books and documents belonging to the office. Accordingly, the manuscript records of observations at stations of various kinds find a place in the room of the superintendent of statistics. The original working charts of the Daily Weather Service are housed with the files of daily synchronous charts of all kinds in the forecast room, a spacious room on the second floor in direct connection by means of pneumatic tube with the instrument room of the post office. The series of meteorological logs from ships, now exceeding 13,000 in number, is housed in the working rooms of the marine staff; the books of data extracted from them are in the marine superintendent's room or in the passage near by. The stock of instruments is housed in the rooms of the instruments staff, while separate store rooms are set apart for publications and for observatory records. These latter are already too numerous for the accommodation provided. The bound volumes of anemograms are therefore stored on shelves elsewhere, and for the time being the sunshine cards are in the basement, where it is proposed to construct with them a 13-inch wall 50 feet in length and 10 feet high.

One of the main difficulties connected with the removal has been the housing of the enormous collection of records and documents, the accumulation of upwards of fifty-six years. The problem of the ultimate fate of these accumulations is one which has now to be faced.

The new arrangement of the office, which is open to the public, has chiefly in view the educational advantages which a library and museum can afford; but it has another object. One often hears a distinction drawn between routine and research, sometimes to the disparagement of the work of an office. Routine work in meteorology is really and truly cooperative research; if not it ought to be discontinued, for it has ceased to have any object. Research in the more restricted sense means personal research upon a subject selected by the individual taste. In co-operative research one cannot choose one's subject; it has been chosen for us by international agreement, by conferences and congresses, by committees perhaps, or by other circumstances over which we have no immediate control. What is still left to our free choice is whether the co-operative research shall be manifestly our research or other people's research. Routine becomes sterile when it is a listless contribution to other people's research. To keep cooperative research alive we need to keep very close up to the working face of the bore into the unknown. It may take a generation or more to carry the whole work through, and premature publication may be worse than routine. To put the record of our progress in a shape in which it can be seen by those who appreciate it, as well as those who do not, gives us a place in the ranks of conscious workers for a definite, even if a distant, object.

W. N. Shaw.

THE CLAIMS OF SCIENTIFIC RESEARCH.

THE anniversary dinner of the Royal Society was held as we went to press last week. Lord Robson proposed the toast of "The Royal Society," and it was replied to by Sir Archibald Geikie, K.C.B., president of the society. In the course of his remarks, Lord Robson pointed out that in nearly every direction the labour and research of science, however remote they may sometimes seem from the affairs of the workshop or the office, are opening up new and almost illimitable sources of wealth and new avenues of profitable employment. It is the man of science who is to decide the fate of the tropics; not the soldier, or the statesman with his programmes and perorations, but the quiet entomologist. He is the man of science who of all others strikes popular imagination the least, and gets less of popular prestige; but he has begun a fascinating campaign for the sanitary conquest of those enormous tracts of the earth, and before long he will have added their intensely fertile soil, almost as a free gift, to the productive resources of the human race. The report in the *Times* states that Lord Robson continued as follows:—

"Not long ago it was my duty to consider legislation in reference to the most complicated problems of overcrowding in cities. That is essentially a problem for statesmen, but not for statesmen alone. Perhaps the most hopeful attack on overcrowding is being unconsciously made by those men of science who have lately done so much to improve the transmission of electric power. They are on the way to make it possible and profitable for factories to establish themselves away from cities and coal-pits, and yet have the exact amount of power they want each day for their machinery sent down to them every morning by wire at a trivial cost. Some day manufacturers will begin to go back to the land, and we shall regard engine-building or soap-boiling as rural occupations. We look to you, the men of science, and almost to you alone, to ensure, not only that our centres of population shall not be congested, but also that our cities, now smoke-laden and devitalised, shall not be polluted. I have spoken of a sanitary conquest of the tropics. Give us also a sanitary conquest of the air of England. What a programme of social reform the Royal Society has got! Yet I have not heard that you are making any claims on the Development Fund. In all seriousness and earnestness, I contend that you ought to be the most favoured, as you would certainly be the most meritorious, of all claimants on that reservoir of national generosity. The various sections and interests who are on the way to absorb it all

are seeking, I believe, without exception, to advance the material interests of those whom they represent. The claims which you put forward on behalf of experimental research would be wholly unselfish. They would be for work in the common interest, in the interest of mankind. In the report for the year there is a very long list of work done in different departments of scientific research with small sums like 10*l.* or so given out of your small Government grant to meet expenses. It is a list capable of indefinite expansion, and indicates work that might be done on a larger and more fruitful scale. Undertakings like the Research Commission to Uganda may well return their cost a hundred-fold, and I venture to suggest that an appeal should be made to those in charge of the Development Fund to give a wider scope to your disinterested and most beneficent activities."

COTTON GROWING WITHIN THE BRITISH EMPIRE.

THE British Cotton Growing Association was inaugurated in 1902 with the object of extending the cultivation of cotton throughout parts of the British Empire where conditions should prove suitable. During the eight years that have elapsed, valuable information has been acquired by means of pioneering expeditions and experimental cultivation in more remote parts of the Empire and from the results yielded by private undertakings that have been liberally assisted with technical advice and financial means. As it was announced a year ago, the inquiry stage is practically completed, and it has been decided to concentrate the main efforts of the association on the work in Nigeria, Uganda, Nyasaland, and the West Indies. The present state and future outlook of the cotton industry are therefore opportunely summarised in the address delivered by Mr. J. H. Reed before the Royal Geographical Society on Monday, December 5.

The principal supply of raw material from the United States of America has increased during the last quarter of a century from seven to thirteen million bales per annum; the output of India may reach a total of five million bales, but most of it is short-stapled, and Egypt supplies somewhat more than a million bales. Against this has to be placed the demand for cotton, which in this country has remained nearly stationary, at a total of three million bales, while the United States of America now require nearly five million bales, and the countries of Europe absorb six million bales. With regard to other sources of supply, the class of cotton grown in the West Indies is of good quality, but owing to the limited area the amount produced can never be large, so that the most hopeful fields for the labours of the association lie in West and Central Africa. The colony of Lagos bids fair to produce an appreciable quantity of cotton; the extension of the industry in Nyasaland, where a superior type of upland is a prominent variety, is distinctly encouraging, and the late High Commissioner of Uganda has reported upon the favourable climate and conditions, as well as the eagerness of the natives in that Protectorate for taking up cotton cultivation. In the Sudan there are large areas of suitable land near the junctions of the Atbara and the Blue Nile with the main stream, in the province of Berber, and on the plains between the converging courses of the Blue and White Nile. Of the prospects in Rhodesia it is too early to pronounce a definite opinion, but the experimental work gives promise of the possibility of a native industry being developed under European guidance.

PESTS OF FRUIT TREES.

A FRUIT-GROWERS' conference was held, in conjunction with the National Fruit-growers' Federation, at Wye College, Kent, on December 2. Nearly six hundred persons, mostly fruit-growers in Kent, attended. The papers of scientific interest were read by Mr. F. V. Theobald, vice-principal and entomologist at the college, and by Mr. E. S. Salmon, mycologist.

Mr. Theobald dealt with the damage done to fruit trees by Thrips. At least three species of Thrips damage fruit trees and bushes, the commonest, apparently, being *Euthrips pyri*, Daniel. This species is found on apple, pear, plum, raspberry, loganberry, and strawberry. The winged adult females first enter the opening buds, and then by means of their conical mouths so lacerate the young tissue that the buds die soon after opening. Leaves and blossoms are also attacked. The ova are laid in slits cut by the female in the young leaves and strigs. The pale, wingless larvæ attack the young fruitlets, which either crack and drop off prematurely, or, if less injury is done on somewhat larger fruitlets, the abrasions lead to the formation of areas or scars, which disfigure or even entirely ruin the fruit. The larvæ when mature enter the soil, and there produce a pupal stage with long wing buds, and the winged Thrips appear again. The winter is passed in the larval stage in the earth. Treatment with soil fungicides appears to be the only practicable method of dealing with this fruit pest.

Mr. E. S. Salmon dealt with the epidemic outbreak of *Eutypella prunastri*, which during the past few years has destroyed thousands of young fruit trees in certain districts in Kent, Herefordshire, and Worcestershire. In one case near Canterbury 1200 "Victoria" plums, 300 "Czars," and 50 "Monarchs" were attacked and killed. The variety of plum called "Rivers Early Prolific" appears to possess powers of resistance to Eutypella. Young apple and cherry trees have also been destroyed by this disease.

The life-history of the apple "scab" fungus (*Venturia inaequalis*) was dealt with, and instances were given which showed that this disease can be successfully prevented by the use of the fungicide known as "Bordeaux mixture." The statement sometimes made by growers that the "scab" fungus can infect and spread on stored apples is due to an error of identification. Recent investigations made by Mr. Salmon show that we have in this country a species of Leptothyrium, not hitherto reported, which attacks apples both on the tree and in the fruit-room, and forms sooty-looking spots on them. It is probably the species *L. pomi*, well known in America as the cause of the "sooty blotch" and "fly speck" diseases.

Evidence was adduced as to the different degrees of susceptibility to injury from Bordeaux mixture shown by different varieties of English apples.

THE DISCOVERY OF NEPTUNE. LEVERRIER'S LETTER TO GALLE.

WHILE so much has been written about the dramatic discovery of the outermost known planet, it is strange that until quite recently the full text of the letter in which Leverrier announced to Galle the results of his wonderful investigations appears not to have been published.

A copy of this historic document was communicated by its recipient to Dr. See about five years ago, for use in a work on the planetary system which the latter was then preparing. But the death of Galle in July last has prompted Dr. See to anticipate the issue of his work by publishing the letter by itself in No. 8, vol. xviii., of *Popular Astronomy* (October, p. 475). The ostensible reason for writing to Galle was to acknowledge the receipt of the memoir which the latter had prepared, and in which he had reduced and critically discussed Roemer's synopsis of three days' work, which alone escaped the conflagration of 1728, under the title "O. Roemer's Triduum Observatorium Astronomicarum a. 1706 Institutorum" (Berlin, 1845). The letter runs as follows:—

"*Paris, le* 18 *septembre* 1846.

"MONSIEUR

"J'ai lu avec beaucoup d'intérêt et d'attention la réduction des observations de Roemer, dont Vous avez bien voulu m'envoyer un exemplaire. La parfaite lucidité de Vos explications, la complète rigueur des résultats que Vous nous donnez, sont au niveau de ce que nous devions attendre d'un aussi habile astronome. Plus tard, Monsieur, je Vous demanderai la permission de revenir sur plusieurs points qui m'ont intéressé, et en particulier sur les observations de Mercure qui y sont renfermées. Aujourd'hui, je voudrais obtenir de l'infatigable observateur qu'il voulût bien consacrer quelques instants à l'examen d'une région du Ciel, où il peut rester une Planète à découvrir. C'est la théorie d'Uranus qui m'a

conduit à ce résultat. Il va paraître un extrait de mes recherches dans les *Ast. Nach.* J'aurais donc pu, Monsieur, me dispenser de Vous en écrire, si je n'avais eu à remplir le devoir de Vous remercier pour l'intéressant ouvrage que Vous m'avez adressé.

"Vous verrez, Monsieur, que je démontre qu'on ne peut satisfaire aux observations d'Uranus qu'en introduisant l'action d'une nouvelle Planète, jusqu'ici inconnue: et ce qui est remarquable, il n'y a dans l'écliptique qu'une seule position qui puisse être attribuée à cette Planète perturbatrice. Voici les éléments de l'orbite que j'assigne à cet astre :

Demi-grand axe de l'orbite	36,154
Durée de la révolution sidérale	217 ans,387
Excentricité	0,10761
Longitude du périhélie	284° 45′
Longitude moyenne : 1er janvier 1847	318° 47′
Masse	$\frac{1}{9300}$
Longitude héliocentrique vraie au 1er janvier 1847	326° 32′
Distance au Soleil	33,06

"La position actuelle de cet astre montre que nous sommes actuellement, et que nous serons encore, pendant plusieurs mois, dans des conditions favorables pour le découvrir.

"D'ailleurs, la grandeur de sa masse permet de conclure que la grandeur de son diamètre apparent est de plus de 3″ sexagésimales. Ce diamètre est tout-à-fait de nature à être distingué, dans les bonnes lunettes, du diamètre fictif que diverses aberrations donnent aux étoiles.

"Recevez, Monsieur, l'assurance de la haute considération de Votre dévoué serviteur

"U.-J. LE VERRIER.

"Veuillez faire agréer à Mr. Encke, bien que je n'aye pas l'honneur d'être connu de lui, l'hommage de mon profond respect.

"A Monsieur J. GALLE,
"Astronome à l'Observatoire Royal de
"Berlin, à Berlin."

THE NEW ZEALAND SURVEY.

IN a report which has recently been published, the Surveyor-General of New Zealand describes the work of his department during the year 1909–10. A large area of country has been surveyed, but the urgency for pushing forward the topographical and settlement surveys, and the survey of native lands, leaves little opportunity for dealing with the major triangulation of the country. It is satisfactory, however, to see that besides some 320 square miles of minor triangulation, a commencement of a secondary triangulation has been made, and a base-line some eight miles in length has been measured. There is said to be a pressing need for this form of control, which may "bring into harmony different groups of practically uncontrolled minor work with their different standards of length, &c." The experience of many other regions goes to show that not only is such control indispensable, but adequate expenditure on it is the best economy, and very soon repays itself.

As the report is arranged by districts, it is difficult to appreciate fully the character of work done; but the demand for land surveys on large scales is very large, and the want of ample and accurate triangulation of second- as well as the present third-order series is no doubt a real one.

The measurement of a base of the secondary triangulation at Wairarapa was carried out with two five-chain invar tapes; a third of greater width, a quarter of an inch instead of an eighth, was also used for the first two sections only. The tension was determined by a Salter spring balance, and not by weights, as is now the more usual method. The tapes were supported at intervals of fifty links by special stands. Four measurements were made of all sections, two with each tape, and of the first four two additional measurements were made; the probable error of the final value adopted for the base is given as 1 part in 2,962,000. The standard of length for controlling the invar tapes was a steel 100-link tape, of which the true length was known at 62° F. and under a tension of 15 lb., but not its coefficient of expansion and modulus of elasticity. A second base is now in hand, and with the increase of this important high-grade work greater facilities for comparison and verification of base apparatus will doubtless be introduced. The work of the department also includes the harmonic analysis of the tidal observations of the Dominion for the New Zealand Nautical Almanac, and arrangements have been made to furnish advance proofs to the Admiralty.

The work of the magnetic observatory has provided an unbroken series of magnetograms from the Adie instruments, and also a large number of seismograms from the Milne seismographs.

THE JAPAN MAGAZINE.[1]

THE great development of Western education in Japan has naturally led to the extensive publication of newspapers and magazines of a very varied kind, and many of them are of a high literary, scientific, or philosophical quality. *The Japan Magazine* is one of the most recent additions, and although its editor seems to be a European, almost all the writers are Japanese. The issue for October, which has just come to hand, is a very good combination of readable matter, which at the same time is of great interest to all who know Japan.

The first article is on "Torii," the characteristic and picturesque gateways to be found at the entrance to every Shinto shrine. It is one of the best which we have seen, and is illustrated by some of the most striking examples in the country. Mr. Seiichi Tejima, the director of the Higher Technological School in Tokyo, gives an interesting description of the organisation and work of his school which will be read with advantage by those engaged in similar work in this country. In addition to the technical part of the curriculum, the importance which is given to the training of character should be specially noted. Mr. Tejima points out that a person engaged in any occupation may be tempted to bargain his honour for venal purposes if the basis of his morals is not sound, and thereby lose the credit of an expert, and it is therefore the school's principal line of policy in education to give moral training on one hand and engineering practice on the other. Mr. Tejima was recently in London in connection with the Japan-British Exhibition, and no doubt some of our readers made his acquaintance and admired the exhibit shown by his school and other educational institutions in Japan. Viscount Taneko, the well-known statesman and writer, gives some readable reminiscences of American statesmen which throw interesting sidelights on some of the problems arising between America and the Far East.

The chief city engineer of Tokyo, Mr. Benjiro Kusakabe, has a descriptive article on "The New Tokyo," which gives a good idea of the transformation which has taken place and almost made the city unrecognisable by those who knew it in former times. Of course this magic transformation is, after all, not so marvellous as it appears, for the reconstruction of a city of wood cannot be regarded as so colossal a task as would be the rebuilding of a stone city like London or Berlin. But the story of the modernisation of Tokyo is none the less interesting as an indication of the tact, skill, and expedition with which the Japanese attempt and achieve great things, and Mr. Kusakabe thinks that when all the new buildings now either in course of construction or contemplated in the near future are completed, and the city's plan of public improvements carried out, Tokyo will be, both in appearance and reality, one of the finest capitals in the world.

Mr. Yaichi Haga tells "How Western Civilisation came to Japan," and Mr. Yoso Kubo, of the Investigation Bureau, has an important article on "The Remaking of Manchuria," which explains Japanese policy and methods in that part of the world. There are very good articles on "The Art of Judo," or of physical training, with special relation to its ethical aspects, on the "Silk Indus-

[1] Published by the Japan Magazine Co., Tokyo. Subscription, in Japanese Empire, per year in advance, 4.50 yen, in foreign countries 6.100 yen.

try," on "Fruit Culture in Japan," and on "The Art of Flower Arrangement," as well as others of special interest to all who study things Japanese. Altogether, the magazine makes very good reading, and if it maintains the standard of the issue which we have been considering it will take a high place among publications on the Far East.

H. D.

RADIATION FROM HEATED GASES.[1]

On the Radiation from Gases.

IN the first and second reports of the committee reference was made to the part played by radiation in the cooling of the products of an explosion, and to its bearing on the measurements of volumetric and specific heat with which those reports were principally concerned. The general question of radiation from heated gases has, however, from the point of view of the committee, an interest and importance of its own which are sufficient to justify a detailed study of it in its wider aspects. Radiation plays a part comparable with that of conduction in determining the heat-flow from the gas to the cylinder walls in the gas engine, and it is this flow of heat which is the most important peculiarity of the gas engine, and to which are chiefly due the leading characteristics of its design. Even to the uninstructed eye the most obvious features about large internal-combustion engines are the arrangements for cooling, and the great size and weight for a given power which is necessitated mainly by those arrangements. The difficulties which the designer has to meet are due in the main to the stresses set up by the temperature gradients which are necessary to sustain the flow of heat. In the present state of the art it is probable that the most important service which science could render to the gas-engine constructor would be to establish definitely the principles upon which depends the heat-flow from hot gases into cold metal with which they are in contact, and thus to enable him to predict the effect upon heat-flow of changes in the temperature, density, or composition of the charge, and in the state of the cylinder walls.

The committee does not propose in this report to deal with the whole of this large question, but will confine its attention to one important factor in heat-flow, namely, radiation. The subject is a wide one, which has excited much attention among physicists and chemists, and on several important points agreement has not yet been reached. No attempt will therefore be made to do more than state shortly the experimental facts, and to define the issues which have been raised in regard to the explanation of these facts.

Practical Effects of Radiation.

It is believed that the first instance in which radiation from a flame was used in an industrial process, with knowledge of its importance, was the regenerative glass furnace of Frederick Siemens, which he described at the Iron and Steel Institute in 1884. Here the combustible gas was burnt in a separate chamber, and the hot products of combustion were led into the furnace. The objects to be heated were placed on the floor of the furnace out of contact with the stream of flame which flowed above them. They would therefore receive heat only by radiation, and it was supposed that this radiation came in a large measure from the flame. Siemens, however, was of opinion (in 1884) that the radiation was due to incandescent particles of carbon, and that there was little radiation from a non-luminous flame.[2]

In 1890 Robert von Helmholtz measured the radiation from a non-luminous coal-gas flame 6 mm. diameter, and found it to be about 5 per cent. of the heat of combustion.[3] The radiation from a luminous flame was greater, but not very much greater—rising to a maximum of $11\frac{1}{2}$ per cent. for an ethylene flame. Discussing the Siemens furnace in the light of these results, R. von Helmholtz calculated that radiation from the flame in the furnace could only account for a small fraction of the actual heat transmission. He pointed out, however, that a large flame would probably radiate energy at a greater rate than a small one. But while admitting that for this reason gaseous radiation might play a part in the heat transmission, he suggested that a more important agent was radiation from the roof of the furnace, which received heat by direct contact with the hot gas, and so reached a very high temperature. He showed by calculation that a comparatively small excess of temperature in the roof over that of the floor would cause a sufficient flow of heat.

[1] From the Third Report of the British Association Committee, consisting of Sir W. H. Preece (Chairman), Mr. Dugald Clerk and Prof. Bertram Hopkinson (Joint Secretaries), Profs. Bone, Burstall, Callendar, Coker, Dalby, and Dixon, Dr. Glazebrook, Profs. Petavel, Smithells, and Watson, Dr. Harker, Lieut.-Col. Holden, Capt. Sankey and Mr. D. L. Chapman, appointed for the Investigation of Gaseous Explosions, with special reference to Temperature. Presented at the Sheffield meeting of the Association, 1910.

[2] Capt. Sankey has prepared an abstract of papers relating to the Siemens furnace.

[3] "Die Licht- und Wärmestrahlung verbrennender Gase," Robert von Helmholtz. (Berlin, 1890.)

But though the discussions on the Siemens furnace and the work of Helmholtz show that the idea that a flame, even if non-luminous, might radiate large amounts of heat, was a familiar one to many people twenty years ago, its possible importance in causing loss of heat during and after a gaseous explosion, and in determining the heat-flow in a gas engine, does not appear to have been appreciated until quite recently. Prof. Callendar was probably the first to direct attention to its significance in this connection. In the discussion on a paper about explosions, read before the Royal Society in 1906, he said that he had found a non-luminous Bunsen flame to radiate 15 to 20 per cent. of its heat of combustion, and expressed the opinion that the loss from this cause in a closed-vessel explosion would be of the same order.[1]

There are, in fact, several points about the behaviour of gas engines which suggest the importance of radiation as a cooling agent. The particular matter which attracted Callendar's attention was the effect of speed on thermal efficiency. His experiments showed that a part of the loss of efficiency in an internal-combustion motor, as compared with the corresponding air-cycle, was independent of the speed at which the engine was run. The loss of heat per cycle could, to a first approximation, be represented by an expression of the type $A+B/n$, where n is the number of revolutions per minute and A and B are constants. The term A represents a constant loss of heat per explosion, and among the many causes contributing to this constant loss of heat, radiation from the flame is probably important.[2]

Another phenomenon which is difficult to explain, except as the result of radiation, is the effect of strength of mixture on heat-loss. The following table shows some results which were obtained by Hopkinson upon a 40 horse-power gas engine[3]:—

Percentage of gas in cylinder contents	8·5	11·0 per cent.
Total heat-loss per minute	1510	2300 B.Th.U.
Total heat-loss as percentage of total heat-supply	29	34 per cent.
Temperature of piston	300° C.	430° C.

It will be observed that the proportion of heat-loss to the walls increases very materially as the strength of mixture is increased. If the transfer of heat were wholly due to conduction it might be expected, apart from the disturbing influence of speed of ignition, which in this case was not very important, that the percentage of heat-loss would rather diminish with increase of charge, because the temperature with the stronger mixture should be relatively less on account of the increase of volumetric heat. The increased temperature of piston and valves would work in the same direction. The existence of radiation, however, which increases more rapidly in proportion to the temperature, would account for the increased heat-flow. The practical importance of questions of this kind is illustrated by these figures, from which it appears that the piston is 50 per cent. hotter, though the charge of gas is only increased 30 per cent.

More direct evidence of the importance of radiation is furnished by experiments on the effect of the surface of the walls. In the second report of the committee reference was made to the belief, which is widely spread among those who are concerned with the practical design and operation of gas engines that polishing the interior of the

[1] Hopkinson, Proc. Roy. Soc., A. vol. lxxvii., p. 400.
[2] Proc. Inst. Automobile Eng., June, 1907.
[3] Proc. Inst. C.E., vol. clxxvii. (1909).

combustion chamber tends to increase efficiency. Some experiments were also quoted in which it was found that lining an explosion vessel with bright tinfoil perceptibly retarded the cooling of the products. More recently an explosion vessel has been plated with silver on the inner surface, and the results have been compared after exploding identical mixtures, first when the lining was highly polished, and secondly when it was blackened over with lamp-black. It was found that by highly polishing the interior of the vessel the maximum pressure reached could be increased 3 per cent., and the subsequent rate of cooling during its earlier stages reduced by about one-third. These experiments leave no doubt of the reality and of the practical importance of radiation as a factor in determining the heat-loss in the gas engine.[1]

Reference may also be made to the part played by radiation in determining the heat-flow in a boiler. Attention was directed to this by Dalby in a recent report to the Institution of Mechanical Engineers.[2] The circumstances in this case are widely different from those usually obtaining in the gas engine, but the instance serves to emphasise the importance to the engineer of the questions which will be discussed in this report.

Amount of the Radiation from Flame.

R. von Helmholtz appears to have been the first to attempt the accurate measurement of the radiation emitted by a flame. He found that a "solid" flame 6 mm. diameter, burning coal-gas, radiated about 5 per cent. of the total heat of combustion. A carbon monoxide flame radiated about 8 per cent., and a hydrogen flame about 3 per cent. On account of the smallness of the flame his experiments have not much application to the problem of the gas engine. The size of the flame affects the matter in two ways. In the first place, a large flame radiates more per unit of area than a small one, because a flame is to a great extent transparent even to its own radiation, so that radiation is received, not only from molecules at the surface of the flame, but also from those at a depth within it. This matter will be further dealt with in another section of the report. The second point is that the cooling of the gas is slower in a large flame than in a small one. The radiation originates in the vibration of the CO_2 and steam molecules, and the life of one of these molecules as a radiating body extends from the moment of its formation to the time when its vibrational energy has been destroyed by radiation and by collision with colder molecules, such as those of the air surrounding the flame. The smaller the flame the more rapid will be the extinction of the vibrations, and the less, therefore, the total amount of radiation per molecule. The products of explosion in a closed vessel or in a gas engine differ considerably in this respect from any open flame, however large, which it is possible to produce, for they are not subject to cooling by mixture with the outside air. Moreover, the density of the gas is very much greater.

Callendar has repeated some of Helmholtz's experiments on a larger scale, and has found that the radiation in a non-luminous coal-gas flame 30 mm. in diameter may amount to 15 per cent. of the whole heat of combustion. Further reference will be made to Callendar's work under the heading of "transparency."

Hopkinson has recently made measurements of the radiation emitted in the course of an explosion in a closed vessel and subsequent cooling. A bolometer made of blackened platinum strip was placed outside a window of fluorite in the walls of the explosion vessel. The electrical resistance of this bolometer was recorded by means of a reflecting galvanometer throwing a spot of light on a revolving drum, and an optical indicator traced simultaneously a record of the pressure on the same drum. He found that the total heat radiated during an explosion of a 15 per cent. mixture of coal-gas and air, and the subsequent cooling, amounted to more than 22 per cent. of the whole heat of combustion. The radiation which had been received at the moment of maximum pressure amounted to 3 per cent., and it continued, though at a diminishing rate, for a long period. Radiation was still

[1] Hopkinson, Proc. Roy. Soc., A., vol. lxxxiv. (1910), p. 155.
[2] Proc. Inst. Mech. Eng, October (1909).

perceptible half a second after maximum pressure, when the gas-temperature had fallen to 1000° C.[1]

Nature and Origin of the Radiation from Flames.

In the gas-engine cylinder and in explosion experiments we are usually concerned with flames in which there is some excess of air. A mixture of similar composition burnt at atmospheric pressure would give an almost non-luminous flame; in the gas engine there is more luminosity on account of the greater density. There is, however, no reason to suppose that the radiation in the gas-engine cylinder differs materially as regards its quality or origin from that emitted by an open flame.

A very complete analysis of the radiation from different kinds of flame was made by Julius, and his experiments leave no doubt that the radiation is almost wholly due to the CO_2 and steam molecules. He examined the spectrum of the flame by means of a rock-salt prism, and he found that in all flames producing both CO_2 and steam most of the radiation was concentrated into two bands, the wave-lengths of which are, respectively, $4 \cdot 4\ \mu$ and $2 \cdot 8\ \mu$. In a pure hydrogen flame the 4·4 band disappears completely, but the other remains; and in the pure CO flame the 2·8 band disappears, the other remaining. These results are independent of the nature of the combustible gas, the spectrum depending solely on the products of combustion.[2]

A confirmation of the statement that the radiation from these flames originates in the CO_2 and H_2O molecules only was furnished in the course of the work by R. von Helmholtz, to which reference has been made above. He measured the amount of radiation per litre of gas consumed, emitted by flames of given size burning, respectively, hydrogen, carbon monoxide, and certain compound gases, such as methane, giving both CO_2 and steam. The supply of air was adjusted in each case so that the flame was just non-luminous. His results are best given in his own words, but it should be stated that he worked with a small flame about 6 mm. diameter and measured the radiation with a bolometer, taking the steady change of its resistance as a measure of the amount of radiation falling upon it:—

"According to the experiments of Julius described in the first chapter, the *quality* of the radiation of flames depends only on the nature of the burnt and not on that of the burning gases. It is relevant to inquire whether the *quantity* of radiation is also dependent on the mass of the products of combustion. I have calculated in the second and third columns below how many litres of H_2O and CO_2, respectively, arise theoretically from each litre of combustible gas. I then assume that for every litre of water produced as much radiation is sent out as corresponds to the radiating power of a hydrogen flame—for this gas yields one litre of H_2O per litre of combustile—and that in a corresponding way the radiation from one litre of carbonic acid would be determined by the radiating power of the carbonic oxide flame, and I can then calculate the radiation from the non-luminous flames of methane, ethylene, and coal-gas.

	Litres		F	
	H_2O	CO_2	Observed	Calculated
Hydrogen	1	0	74	—
Carbon monoxide ..	0	1	177	—
Marsh gas	2	1	327	325
Ethylene	2	2	510	502
Coal gas...	1·2	0·5	181	179

"The correspondence between the calculated numbers with the radiation from a flame which has just been rendered non-luminous surprised me the more since the latter is conditioned, in some measure, by the volume of air mixed with the gas, and this is very different for the three non-luminous flames. On this account it cannot be asserted that this agreement is not accidental. Moreover, the number of observations is much too small. Nevertheless, the experiment seems worthy of record and will be followed up further."

[1] Proc. Roy. Soc., A., vol. lxxxiv. (1910), p. 155.
[2] "Die Licht- und Wärmestrahlung verbrannter Gase," Dr. W. H. Julius. (Berlin, 1890.)

With regard to the last remarks, it is to be noted that the fact that the flame was just rendered non-luminous shows that the air was in each case in approximately the proportion required for complete combustion. The heating value of such a mixture is much the same for all the gases in the above table, and the temperatures of the flames would be still more nearly the same, the higher heating value of a CO mixture being partly neutralised by the high specific heat of the products. The agreement is certainly more than a coincidence. W. T. David, from a comparison of the radiation emitted in the steam and CO bands, respectively, in a coal-gas and air explosion, infers that CO_2 radiates about $2\frac{1}{2}$ times as much as steam per unit of volume. This result, which was obtained in ignorance of Helmholtz's estimate, agrees with it almost exactly.

Cold CO_2 shows a strong absorption band at the same point of the spectrum as the emission band given by a flame in which CO_2 is produced, and water vapour powerfully absorbs the radiation from a hydrogen flame.

As stated above, it is most probable that the radiation in an explosion also consists almost entirely of the same two bands as are emitted by the Bunsen flame. A complete analysis of the radiation from an explosion has not been made, but Hopkinson and David found, using a recording bolometer, that the radiation is almost completely stopped by a water-cell, and that it is largely stopped by a glass plate. It follows that the luminosity of the flame in an explosion or in a gas engine accounts for but little of the energy which it radiates.

Molecular Theory of Radiation from Gases.

Much difference of opinion exists as to the physical interpretation of the facts described in the preceding sections. The issues in this controversy can conveniently be stated in terms of the molecular theory, and it is therefore desirable to give a short account of this theory. But it will be apparent that the issues are not merely of theoretical interest, but are in large measure issues of fact capable of being tested by experiment, and that the answers to important practical questions may depend on the manner in which they are settled.

According to the kinetic theory, the energy of a gas must be referred partly to translational motion of the molecules as a whole and partly to motions of some sort internal to the molecules. The translational motion is that which causes the pressure of the gas, and in the case of gases for which pv/θ is constant (with which alone we are concerned in this discussion), the translational energy per unit of volume is equal in absolute measure to $1\frac{1}{2}$ times the pressure. This part of the energy may conveniently be called "pressure energy." It amounts to nearly 3 calories per gram molecule, or to 12 feet lb. per cubic foot per degree centigrade.

The other part of the energy produces no external physical effect except radiation, and at ordinary temperatures, when there is no radiation, its existence and amount are inferred from the fact that when work is done or heat put into the gas the corresponding increase in pressure energy amounts to only a fraction of the whole. The internal motions to which this suppressed energy corresponds may be pictured as of a mechanical nature, such as the vibrations of spring-connected masses or as rotation about the centre of gravity of the molecule, but there is not the same reason as exists in the case of the translational energy for supposing that they are really of this character. They may be, and indeed probably are, electrical phenomena, at any rate in part. Any radiation from the gas must take its origin in this internal motion, and so much of that motion as gives rise to radiation must be of a periodic character and have a frequency equal to that of the radiation emitted. It will be convenient to call the whole energy which is internal to the molecule "atomic energy," and that part of it which gives rise to radiation may be called "vibrational energy." The vibrational energy may be imagined as due to high-frequency vibrations within the molecule, and the rest of the atomic energy as due to slower movements—perhaps rotations of the molecule as a whole—which do not produce any disturbance in the æther. This remaining energy may conveniently be called "rotational," it being understood that the motion to which it corresponds is not necessarily a physical rotation, but is some internal motion which gives no external physical effects.

When the gas is in a steady state the various kinds of energy will bear definite ratios to one another, dependent on the temperature and pressure. It may be expected, however, that after any sudden change of temperature or pressure the gas will not at once reach the steady state of equilibrium corresponding to the new conditions. For instance, it may be that in the rapid compression of a gas the work done goes at first mainly to increasing the translational energy. If in such case the compression be arrested, and if there be no loss of heat, this form of energy will be found in excess; and a certain time, though possibly a very short time, will elapse before the excess is transformed by collisions into atomic energy and the state of equilibrium attained. This change would be manifest as a fall of temperature or of pressure without any change of energy.

If, on the other hand, the gas be heated by combustion, the first effect is undoubtedly an increase in the energy of those molecules, and of those only which have been formed as the result of the combustion; and it is probable that in the first instance the energy of the newly formed molecules is mainly in the atomic form. Before equilibrium can be attained there must be a process of adjustment, in the course of which the energy of the new molecules will be shared in part, with inert molecules, *e.g.* the nitrogen in an air-gas explosion, while the translational form of energy will increase at the expense of the atomic energy. The final state of equilibrium reached will be the same at the same temperature, whether the gas was heated in the first instance by combustion or by compression; the assumption that this is the case is involved in any statement of volumetric heat as a definite physical quantity. The pressure energy in the final state of equilibrium is certainly shared equally between the different kinds of molecules, but the atomic energy is not necessarily equally shared. It is known, for example, that the steam molecules, after an explosion of hydrogen and air, carry, on the average, more energy than the nitrogen molecules, though the pressure energy is the same.

The process of attaining equilibrium after an explosion, which has just been described, would (if heat loss were arrested) result in a rise of temperature, and in the ordinary case of rapid cooling it would retard the cooling. It would, therefore, be indistinguishable as regards pressure or temperature effects from continued combustion or after-burning.

Stated in terms of the molecular theory, the first question as to which there is difference of opinion is whether the radiation from a flame arises from gas which is in equilibrium or whether it comes from molecules which still possess a larger share than they will ultimately (in the equilibrium state) be entitled to of the atomic energy which resulted from their formation. If the products of combustion of a non-luminous Bunsen flame were heated, say, by passing through a hot tube—to the average temperature of the flame (taken to be equal to that of a solid body of moderate extent immersed in it), would they emit substantially the same amount of radiation? In order to clear the ground for the discussion of this question it will be convenient, first, to state two or three points about which there will probably be general agreement. First, there is here no question of the origin of luminosity, for the luminous part of the radiation from the flame possesses practically no energy. Secondly, the radiation, whether in the heated gas or in the flame, arises almost entirely from the compound constituents CO_2 and H_2O; in neither case does any come from the molecules of nitrogen or of excess oxygen. And, thirdly, the powerful absorption of cold CO_2 for the radiation from a CO flame, and of water vapour for that from a hydrogen flame, will probably lead all to admit that these gases when heated will emit *some* radiation of the same type. The only question is, how much?

R. von Helmholtz was of opinion that the radiation in a flame comes mainly from molecules which have just been formed, and which are, therefore, still in a state of vigorous vibration. Pringsheim, Smithells, and others take the same view. This is practically equivalent to saying that this radiation, like the radiation of higher

frequency which gives luminosity, is due to chemical action and not to purely thermal causes. On the other hand, Paschen and some others have maintained that the radiation from a flame is purely thermal, or that it arises from gas which has attained the normal or equilibrium state, and is substantially the same as that which would be emitted if the products of combustion were heated.

It will readily be seen that the difference between the two opinions really turns on the question of the time taken by a gas which is not initially in, or has been disturbed from, the equilibrium state to attain that state. All will concede that the CO_2 or steam molecule will radiate more powerfully just after its formation than at any other time. If, as R. von Helmholtz contended, the greater part of the radiation which it gives out in the course of its life is to be ascribed to this early period of its history, we must suppose that that period is sufficiently extended to give time for the emission of a considerable amount of energy with a rate of radiation which, though greater than that of the gas in its ultimate equilibrium state, is at least of the same order of magnitude. In other words, we must suppose that the process, which may indifferently be called attainment of equilibrium or continued chemical action, must go on in the gases as they pass through the flame for a time of the order perhaps of one-tenth of a second. For if it be supposed that equilibrium is reached in an excessively short time, say in 1·1000 second or less, then the radiation, if ascribed to that short period, must be supposed to be of corresponding intensity—there must be a sudden and violent flow of energy by radiation just while combustion is going on, and very little radiation after it is complete. This is, however, negatived by the bolometer measurements made during an explosion, which show that radiation goes on for something like half a second after maximum pressure. Those who hold that the radiation emitted by CO_2 and steam is mainly due to continued combustion must be prepared to admit that such combustion goes on for a long period after the attainment of maximum pressure in an explosion. The issue involved here is, in fact, the same as that in the controversy about "after-burning."

The principal argument advanced by R. von Helmholtz in support of his view is the experimental fact discovered by him that the radiation of a flame is diminished by heating the gas and air before they enter the burner, in spite of the fact that the temperature of the flame must be raised. This he explains by the acceleration of the approach to the state of equilibrium which would be brought about by the more frequent collisions between the newly formed compound molecules and their neighbours.

The question of the velocity with which a gas approaches its normal state after a disturbance has been much discussed in connection with the kinetic theory. Immediately after an explosion we have an extreme case of such a disturbance, the atomic energy being, at any point which the flame has just reached, in considerable excess. The transformation of this energy into the pressure form will proceed at a rate diminishing with the amount remaining to be transformed and, in the final stages of the process at all events, proportional thereto. The slowness of approach to the state of equilibrium may be measured by the time required for the reduction of the untransformed energy in any specified ratio. It is usual to take $1/e$ as this ratio, and, following Maxwell, the corresponding time may be called the "time of relaxation." Estimates of this time, based on the kinetic theory of gases, may be made in various ways, but they all involve hypotheses as to the nature of the action between the molecules, and must be regarded as little more than speculation. It will be well, however, to indicate the general character of the arguments on which they are based. By methods which need not be considered in detail here, it is possible to calculate the number of collisions with its neighbours which the average molecule undergoes per second. This calculation can be approached in various ways, based on different kinds of data, but they all lead to the same result, at any rate as regards order of magnitude, namely, that a molecule of air at normal temperature and pressure collides, on the average, 3×10 times per second with other molecules. At every collision the energy distribution in the colliding molecules is modified, both as regards the manner in which it is shared between the two and the relative proportions due to vibration and translation in either. It is argued that after every molecule has suffered a few thousand collisions, which will happen in a millionth of a second, the gas must have reached a steady average state. This argument would, however, be upset if the interchange of energy as between vibration and translation at each collision were sufficiently small. It is only necessary to suppose that a vibrating molecule loses less than one-thousand millionth part of its vibratory energy at each collision to raise the time of relaxation to something of the order of a second. Any objection to this supposition must be founded on some hypothesis, which cannot be other than entirely speculative, as to the mechanism of a collision. The kinetic theory, therefore, can give no information about the absolute value of the time of relaxation, though it provides valuable suggestions as to the way in which that time is affected by the temperature and density of the gas.

There is plenty of physical evidence, however, that in ordinary circumstances the time of relaxation is excessively short. The phenomena of the propagation of sound shows that compressions and rarefactions of atmospheric air may take place many thousands of times in a second without the gas departing appreciably at any instant from the state of equilibrium. The experiments of Tyndall, in which an intermittent beam of radiant energy directed through the gas caused variations of pressure sufficiently rapid to give sounds, show that the transformation of vibrational into pressure energy under the conditions of his experiments is a process far more rapid than any with which we are accustomed to deal in the gas engine or in the study of gaseous explosions. The departure from equilibrium which follows combustion is, however, of a special kind, and it may be that the gas is slower in recovering from it than when the disturbance is that produced by the propagation of sound at ordinary temperatures.

Transparency.

The radiation from hot gas is complicated by the fact that the gas is to a considerable extent transparent to its own radiation. The radiation emitted, therefore, depends upon the thickness of the layer of gas, instead of being purely a surface phenomenon, as in the case of a solid body. This property, besides being of great physical interest, is important from the point of view of the committee because upon it depends, or may depend, the relative magnitude of radiation losses in engines or explosion vessels of different sizes.

The transparency of flames is well illustrated by some experiments which Prof. Callendar has been making, and which he showed to the committee. The radiation from a Mêker burner (which gives a "solid" flame without inner cone) was measured by means of a Fery pyrometer, the reading of which gives a measure of the radiation transmitted through a small cone intersecting the flame and having its vertex at this point of observation (see Fig. 1). Callendar proposes to give the name "intrinsic radiance" to the radiation of a flame measured in this way, divided by the solid angle of the cone. When a second similar flame was placed behind the first in the line of sight, it was found that the reading recorded by the pyrometer was considerably increased, but not doubled; the first flame appeared to be partly, but not completely, transparent to the radiation emitted by the second. A third flame placed behind the first two contributed a further but smaller addition to the radiation, and as the number of flames in the row was increased the radiation received from each fell off according to an exponential law. The total radiation from the whole row (which is that recorded on the pyrometer) tends to a finite limit as the number of flames is increased. The radiation from a depth of 12 cm. is about half, and that from a depth of 100 cm. is within half per cent. of that emitted by an infinitely great depth.

The general result of Callendar's experiments is to show that flames of a diameter of 3 centimetres or less burning at atmospheric pressure emit radiation approximately in proportion to the volume. If the diameter be increased beyond that figure the radiation will also increase, but not in proportion to the volume of the flame. The radiation from very large flames would tend to become proportional to the surface, but no certain inference as to the diameter

of flame for which this would be substantially true can be drawn from Callendar's experiments, because he was looking along a thin row of flames in which there was but little lateral extension.

The flames met with in a gas-engine cylinder or in explosion vessels differ from open flames such as can readily be produced in the laboratory, both in respect of the lateral extension which has just been mentioned and also in respect of density. In both these particulars the difference is rather great, the least dimension of the mass of flame in a gas-engine cylinder being only in the smallest sizes comparable with the diameter of the Mêker burner flame, while the density of the gas just after firing in the gas engine is from twenty to thirty times that of the burner flame gases. It does not seem possible from theoretical considerations to determine the effect of these two factors with sufficient accuracy to enable any quantitative inference as to radiation in the gas engine to be drawn from laboratory experiments on flames, but it is useful to discuss their probable qualitative effects.

In Fig. 1, P is the point of observation at which the pyrometer is placed, as in Callendar's experiments, and the portion of the flame from which the radiation is measured is that intercepted by the small cone. If a second similar flame B is placed behind A at a considerable distance, but so that it is intersected by the cone, then the radiation recorded by the pyrometer will be increased, say, by 50 per cent., showing that of the radiation emitted by B and falling on A 50 per cent. is absorbed and the remainder is transmitted to the pyrometer. The absorbed energy is, of course, not lost, but must result

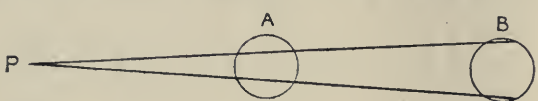

FIG. 1.

FIG. 2.

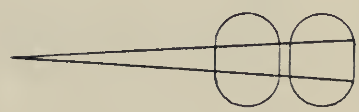
FIG. 3.

in slightly increased radiation from A in all directions. The flame A appears to be a little hotter because of the proximity of B. Thus the increase of radiation absorbed at the pyrometer is due, not only to the radiation transmitted from B, but also to an increase in the intrinsic radiance of A. If the two flames are a considerable distance apart, the latter part is negligibly small, since the flame A does not then receive much radiation from B, and what it does receive is dissipated in every direction. But when flame B is pushed close up to A into the position of B[1] (Fig. 2) this effect may be considerable, and it is obvious that it will be greatly enhanced if the two flames are extended laterally as in Fig. 3. For in such case flame A must get rid of the energy which it is receiving by radiation from B[1], mainly by an enhanced radiation in the direction of P. It may therefore be expected that the effect of lateral extension will be to make the flame apparently more transparent.

To a first approximation it may be expected that the radiating and absorptive powers of a gas at a given temperature will be proportional to its density. That is to say, two geometrically similar masses of flame, in which the temperatures at corresponding points are the same, and the densities in inverse proportion to the volumes (so that the total masses are the same), will radiate in the same way and to the same total amount. It would seem that this must be so, so long as the vibrations of the radiating molecules are the same in character and amplitude in the two cases. For there will then be the same number of molecules vibrating in exactly the same way and arranged in the same way in the two cases. The only difference is in the scale of the arrangement, and this can only affect the matter if the distance between molecules is comparable with the wave-lengths of the radiation emitted, which is not the case. It is only, however, within moderate limits that the molecular vibrations are independent of density. Angström found that the absorption of the radiation from a given source in a tube of CO_2 at ordinary temperature and atmospheric pressure was reduced by increasing the length and diminishing the pressure [1] in the same proportion so as to keep the mass of gas constant. Schäfer found that on increasing the pressure the absorption bands of this gas were widened, so that the curve connecting intensity of radiation and wave-length did not remain of the same shape.[2] These experiments were made at low temperatures, and at the higher temperatures, in which the committee are more particularly interested, there has been but little work. There is no reason to doubt, however, that the character and amount of the radiation from CO_2 and steam at high temperatures will change with the density.

From the point of view of the molecular theory, such a change might be anticipated from either of two causes. An increase of density implies a proportionate increase in the frequency of molecular collisions, and this would result in greater facility of interchange between the translational and atomic types of energy. It is possible that the equilibrium proportion of the two types might be different in consequence. The denser gas may conceivably possess, with a given amount of translational energy, more atomic energy, and therefore radiate more strongly at a given temperature. It is certain that there would be a more rapid attainment of equilibrium in the gas after an explosion or a rapid expansion. Another possible cause is a direct interaction between the molecules, apart from collisions. Two molecules at a sufficient distance apart will vibrate practically independently, each behaving as though the other was not there, except that there will be a tendency for them to vibrate in the same phase. But if the two are close together they react on one another so that the natural period or periods of the two together will not be the same as those which each would have if it were isolated.

Such direct measurements as have been made of the radiation after a closed-vessel explosion suggest that the flame is more transparent than might be inferred from the experiments on open flames. According to information given to the committee by Prof. Hopkinson, W. T. David has found that the radiation received by a bolometer placed outside a fluorite window in the cover of a cylindrical explosion vessel 30 cm. × 30 cm. is greatly increased by highly polishing that portion of the opposite cover which can be "seen" by the bolometer. This implies that a thickness of 30 cm. of flame in these circumstances can transmit much of the radiation which it emits. The density of the gas in this case was atmospheric, and the 30 cm. thickness in the explosion vessel would be equivalent to perhaps 150 cm. of open flame if absorption were simply proportional to density. According to Callendar's experiment, such a thickness would be almost completely opaque. It is possible that the lateral extension is sufficient to account for this result. The open flame should be a cylindrical mass of dimensions 150 cm. × 150 cm., instead of a long strip with a cross-section of 3 cm., in order to make the two cases strictly comparable. It will be remembered that in the discussion above it appeared that the laterally extended flame would seem to be more transparent.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Walsingham medal for 1910 has been awarded to A. V. Hill, of Trinity College. A second medal has been awarded to J. C. F. Fryer, of Gonville and Caius College.

The following have been elected to the Clerk Maxwell scholarship:—R. D. Kleeman and R. T. Beatty, both of Emmanuel College.

At a meeting of the Fitzwilliam Museums syndicate, held

[1] Ark. for Mat. Astron. och Fysik. Stockholm, vol. iv., No. 30, p. 1.
[2] Ann. der Physik, vol. xvi. (1905), p. 93.

on November 29, F. W. Green, of Jesus College, was appointed honorary keeper of the Egyptian antiquities.

OXFORD.—At a Convocation held on December 6, the Vice-Chancellor (Dr. Heberden, Principal of Brasenose) presiding, the honorary degree of doctor of science was conferred on Prof. Meldola, F.R.S., professor of chemistry in the Finsbury Technical College (City and Guilds of London Institute), in anticipation of the Herbert Spencer lecture to be delivered by him on December 8. In making the presentation, the Sedelian professor natural philosophy, Prof. A. E. H. Lowe, F.R.S., delivered the following oration:—

"Adest vir quem omnes, qui scientiae et imprimis Chemiae et Biologiae student, ornare gaudent, Societatis Regalis Sodalis, Societatum Entomologiae, Chemiae, Chemicorum industriae, operam dantium Praeses emeritus, Raphael Meldola. Qui vir cum prima aetate Carolo Darwin coniunctissimus esset, ita de Natura formarum novarum creatrice quaesivit ut plurimis eodem studio incensis illud Biologiae genus quod ipse excoluerat nostratium fere proprium fieret. Posteriora eius studia partim in Physice, partim in Chemia versata sunt, quo e numero si pauca quaedam momenti maximi commemorare liceat, et eligerem quae de Chemia Photographiae inserviente, de chemicis carbonis elementis, de chemica umorum corporalium compositione commentus est. Multos iam annos in hoc Chemiae genere principem habitum atque latissimo in campo evagatum nescio an nemo hunc virum laude superavit."

THE annual prize distribution and students' conversazione of the Northampton Polytechnic Institute, Clerkenwell, E.C., is to be held this evening, December 8. The Right Hon. Lord Alverstone, G.C.M.G., P.C., Lord Chief Justice of England, will distribute the prizes and certificates. Lecturettes will be given by Mr. F. M. Denton on commercial uses of electro-magnets, and Mr. F. Handley Page on how to fly.

DR. EDGAR F. SMITH has been appointed to succeed Dr. C. C. Harrison as provost of the University of Pennsylvania, in which institution he has held a chair of chemistry since 1888. His chief work has been done in electrochemistry, as a list of his principal publications would show. He is a past-president of the American Chemical Society and of the American Philosophical Society. He has also been a member of the U.S. Assay Commission and adviser in chemistry to the Carnegie Institution.

THE annual conversazione of the Royal College of Science and Royal School of Mines will be held on Wednesday, December 21. Both the new and old buildings will be open in Imperial Institute and Exhibition Roads, South Kensington, S.W., and many interesting exhibits will be shown in chemistry, physics, mechanics, metallurgy, mining, botany, and zoology, arranged by the respective scientific societies. During the evening Dr. C. Gilbert Cullis will give a lecture on "Coral Islands."

IT is announced, says *Science*, that Mr. Andrew Carnegie has given a further sum of 300,000*l*. for the construction of buildings of the Carnegie Technical Schools at Pittsburgh. From the same source we learn that by the will of Prof. A. Marshall Elliott the Johns Hopkins University receives his library, and the sum of 400*l*. for the establishment of a scholarship for graduate students; and that the American Museum of Natural History receives 5000*l*. by the will of the late Mr. Charles E. Tilford, of New York City.

STEPS are being taken to inaugurate a Students' Union in connection with Sheffield University. An influential committee, representative of all faculties, has been elected from amongst the members of the Students' Representative Council to proceed with the formation of the union. Sheffield University stands alone amongst the universities of the United Kingdom in not possessing such an institution, and we feel sure that the committee's appeal to members of the University and their friends for contributions to the fund to provide premises where students may be united in the bonds of social intercourse will meet with a generous response. Cheques may be made payable to Mr. H. Khalifa, honorary secretary and treasurer to the Students' Union Committee, The University, Sheffield.

THE Royal Agricultural College, Cirencester, founded in 1845 and reorganised in 1908, is now definitely associated with the University of Bristol for the purpose of instruction in agriculture, forestry, estate management, land surveying, veterinary science, natural history, agricultural chemistry, botany, zoology, and geology, to which other allied subjects may subsequently be added. Instruction given at the college in these subjects to undergraduates will be deemed to be instruction given in and by the University for the purpose of degrees and diplomas in agriculture and forestry. The present principal, Mr. Ainsworth-Davis, is recognised as professor of natural history in the University, and Mr. Drysdale Turner as professor of agriculture, this recognition carrying with it membership of the University Senate. While the association will in no way interfere with the primary work of the Royal Agricultural College, which will still retain its distinctive and time-honoured diploma, a new class of students will come into existence, and an important advance be made in the correlation of agricultural education in the west of England.

UNDER the auspices of the London County Council, another conference of teachers will be held on three days, Thursday, Friday, and Saturday, January 5, 6, and 7, 1911, at Birkbeck College, Bream's Buildings, Chancery Lane, E.C. The programme includes the following subjects, among others:—Thursday, January 5, *Specialisation in Schools:* Addresses by Mrs. Sophie Bryant on the value of specialisation in secondary schools, and F. Bulley on an experiment in specialisation in elementary schools. *Memory:* Addresses by Dr. C. Spearman on the relation of the memory to the will, Dr. E. O. Lewis on some interesting investigations on memory, and Dr. F. H. Hayward on the cultivation of memory. Friday, January 6, *The Teaching of Geography:* Addresses by B. C. Wallis on the teaching of geography in secondary schools, J. Fairgrieve on a practical room for the teaching of geography, and C. J. Rose on open air teaching in geography. Saturday January 7, *Education Experiments in Schools:* Addresses by B. Lewis on a combined scheme of history and geography teaching, E. Thomas on pictorial aids for the teaching of geography and history, A. G. Gawler on how to secure individual work in large classes, J. Greer on an experiment in number teaching, A. E. D. Lowden on stencilling—a valuable form of handwork, and Mrs. Sandford on animals in infants' schools. No charge will be made for admission to the conference. Application for tickets of admission should be made to the Chief Inspector, London County Council, Education Offices, Victoria Embankment, W.C.

BY the passing of the Education (Choice of Employment) Bill into law on the day of dissolution of Parliament, the English and Welsh local education authorities have after a keen controversy been accorded statutory powers to "give boys and girls information, advice, and assistance with respect to the choice of employment." The School Boards of Scotland were put in possession of these powers by the Education (Scotland) Act, 1908, and the School Board of Edinburgh took the lead in making the powers operative. The originator of the conception of a national system of school information and employment bureaux was Mrs. Ogilvie Gordon, D.Sc., who first placed her scheme before the public at the annual meeting of the Glasgow Union of Women Workers, held in March, 1904. The full draft of her scheme was submitted to the President of the Board of Education and to the Secretary for Scotland, and was supported by numerous resolutions passed in its favour at public meetings. It was afterwards published in Mrs. Ogilvie Gordon's "Handbook of Employments" (Aberdeen: Rosemount Press). The aim of the scheme is to bring the teachers' knowledge of the individual boy and girl effectively to bear upon their choice of a future career, and it is based upon the sound economic principle that work on such lines ought to be nationally organised in order to make sure that it should reach every child, and that the work ought to cover all the openings and occupations for our youth—skilled or unskilled, mercantile or personal. By the measure which has at last become law, there is now a prospect of an effective advisory service being organised throughout the country, administered by committees formed under the education authorities, and there should be no difficulty in arrangements being made

locally between the labour exchanges and the education authority, so that no actual overlapping of work shall take place, but each be helpful to the other.

THE annual prize distribution of the Sir John Cass Technical Institute was held on Tuesday, November 29, when Sir William Tilden distributed the prizes and delivered an address; the chair was taken by Sir Owen Roberts, chairman of the governing body. Sir William Tilden, after contrasting the conditions available for obtaining scientific instruction now, in such institutions as that of the Sir John Cass, as compared with his own student days, referred especially to the improved character of the teaching, but pointed out that the responsibility for gaining the full benefit of these advantages rested still, as it did in former years, far more with the students than with the teachers. Whilst the business of the teachers was to be regarded as being concerned with the selection of the subjects to be studied rather than their exposition, the real responsibility for progress must always rest with the student. The assimilation of knowledge is the business of the student, and the greatest inducement and stimulus for such assimilation is the desire for knowledge, a desire which is most advantageously associated with a conviction of ignorance. Sir William Tilden further urged the necessity of the thorough understanding of the subjects taught at each stage of progress, and pointed out that students should not look to their teachers for recipes for doing things, but to their own efforts, as the means of acquiring a full understanding of their work, and that they should not omit becoming fully conversant with the history and meaning of the expressions and words employed in their studies. In conclusion, it was pointed out that with every student there are times when the mind should be allowed to relax a little from the pages of their text-books, and that of the many forms of relaxation it was most desirable that all young English men and women should devote some attention and interest to the history of their own country. The exceptional advantages of London, and especially of the City of London, as a stimulant to such study was particularly referred to, for there is nothing more interesting, more absorbing, or more enchanting than the study of the history of mankind, especially that particular variety of mankind which is represented by the Anglo-Saxon race. Sir William Tilden subsequently opened the new chemistry laboratory which has recently been equipped by the governors of the institute.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 24.—Sir Archibald Geikie, K.C.B., president, followed by Mr. A. B. Kempe, vice-president, in the chair.—Sir Norman **Lockyer**: The sequence of chemical forms in stellar spectra.—A. **Mallock**: Influence of viscosity on the stability of the flow of fluids. The effect of this paper is to direct attention to an observation made by the late Mr. W. Froude, F.R.S., with regard to an experiment on fluid jets, and to its application in explaining some of the phenomena presented by the flow of viscous fluids. The experiment referred to was shown by Froude at the British meeting of the British Association in 1875, and one of the deductions drawn from it was that in a viscous flow the character of the stream differed according as to whether the flow was towards decreasing or increasing pressure.—Horace **Lamb**: Atmospheric oscillations. The paper treats of the free oscillations of an atmosphere, the temperature being a function of the altitude, and the adiabatic laws of expansion being assumed. In particular, the case of a uniform temperature gradient is discussed in some detail. The possible oscillations are of various types, of which the most important is of the character of a longitudinal wave. The results are simplest when the equilibrium state is one of convective equilibrium, and the velocity of the longitudinal wave is then equal to the Newtonian velocity of sound, $\sqrt{(gH)}$, corresponding to the temperature of the lowest stratum. The bearing of the results on Kelvin's theory of the semi-diurnal barometric oscillation is examined, and it appears that the existence of a free period of the earth's atmosphere, of somewhat less than twelve mean solar hours, is highly probable. Other types of oscillation depend for their frequency on the degree of stability of the atmosphere, and may in circumstances be comparatively slow. It is possible that these may account for some of the minor fluctuations of the barometer. The paper includes also an examination of the theory of waves at a surface of discontinuity.—P. J. **Kirkby**: A theory of the chemical action of the electric discharge in electrolytic gas and other gases. The complicated results attending the passage of an electric discharge through electrolytic gas, described in previous papers, and in particular the chemical effects observed in the positive columns of long discharges, were explained by the theory that the chemical action is due to molecular dissociation effected by the collisions of gaseous ions constituting the current with the molecules of the gas, the atoms of which are thus set free to enter into new combinations. In this paper an account is given of experiments designed to determine both the number of molecules of water (w) formed by the passage of the atomic charge through 1 cm. of the positive columns of various discharges passed through electrolytic gas ($2H_2+O_2$), and also the electric force (Y) within these columns, the results providing data for testing and developing the theory. The chemical effects of the positive column are attributed to the motion of the electrons alone. The number of atoms of oxygen set free by the collisions of an electron moving through 1 cm. in electrolytic gas at p mm. pressure under the electric force Y is of the form $cpe^{-bp/Y}$, where c, b are certain constants. Hence, if an atom of oxygen can unite directly with a *molecule* of hydrogen, w is proportional to $cpe^{-bp/Y}$. All the experimental results satisfy this condition within error-limits in the particular form $w/p=7{\cdot}9\,e^{-42{\cdot}7p/Y}$, and thus support the above theory as well as the hypothesis that water-vapour is formed by the collision of an atom of oxygen with a molecule of hydrogen. This equation involves that the energy of formation of an oxygen molecule is less than, and probably nearly equal to, $6{\cdot}\times10^{-12}$ ergs; and experiments of Berthelot upon the heat of transformation of ozone into oxygen are shown to be in fair agreement. An estimate, 7×10^{-12} ergs, is also given for the energy of formation of a molecule of water vapour. These experiments also prove, independently of theory, that dissociated atoms of oxygen are not charged electrically. Similar experiments were made with the gaseous mixture $CO+H_2$. The chemical effects observed in the positive column reproduce the main features observed with electrolytic gas, and are explainable by a similar theory.—G. W. **Walker**: An electrostatic voltmeter for photographic recording of the atmospheric potential. The paper describes some experiments made at Eskdalemuir Observatory with the object of obtaining a simple and efficient voltmeter for continuous photographic registration of the electrical potential at a fixed point in the atmosphere. Experience has shown that occasionally the instrument would require to register up to fully 1000 volts + or −. Satisfactory results have been obtained by means of a Dolezalek electrometer. The usual sensitiveness was greatly reduced by using a phosphor-bronze suspension, while the needle was loaded to prevent tilting. A fixed difference of potential is applied between the quadrants by means of one or two standard cadmium cells, while the potential to be measured is applied to the needle. The needle can now carry 1100 volts with perfect safety and stability, while the scale value on the paper is constant to within a few per cent. over a range from −900 to +900 volts. Trial has been made of a voltmeter (made in the workshop) similar in general design to the Dolezalek, but in which the fixed difference of potential between the quadrants is provided by making the quadrants alternately of copper and zinc soldered together and not insulated. Uniformity of scale value has been obtained from about −500 to +500 volts, but for higher potentials only approximate uniformity was secured. This defect arises from want of mechanical perfection of the quadrants and needle, and should disappear in an instrument made with the same accuracy as the Dolezalek. At present, also, the damping of the needle during very rapid changes of potential is insufficient. Reference is made to certain points in the manipulation of sulphur for insulating, which have been found essential to secure good results.—Dr. T. H. **Havelock**: Optical dispersion: an analysis of its actual dependence upon

physical conditions. The paper is based upon a generalised dispersion formula

$$\frac{1}{\sigma + 1/(n^2 - 1)} \cdot \frac{1}{P} = \Sigma \frac{c_s}{\lambda^2 - \lambda^2_s}$$

where P is the density of the medium. The quantities c_s and λ_s refer to natural vibrations inherent in the molecule, and it is assumed that these are not changed by varying physical conditions, such as temperature, pressure, or density; thus an attempt is made to express these conditions in their optical effect by two variables, P and σ. The scheme is tested first by a relation deduced from the above formula, namely, the difference in value of $P/(n^2-1)$ for any two physical conditions of the same substance is constant in regard to wave-length. From an examination of available data this appears to be satisfied approximately for gases and liquids and for changes from gas to liquid. Numerical values of σ for various substances in different conditions are obtained by assigning it zero value for the gaseous condition at normal pressure and temperature. Artificial double refraction is included in the same formal scheme by allowing anisotropic changes of the quantity σ. Finally, for dispersion formulæ of the above type an observed maximum of absorption (or of selective reflection) is identified, not with λ_s, but with a wave-length λ'_s, differing from λ_s by a term involving P and σ: numerical examples are given for rock-salt and fluorite. The wave-lengths λ'_s are calculated under various conditions for certain substances; experimental data are analysed to show the pressure-displacement for air and the temperature-displacement of absorption maxima for water and carbon disulphide.—C. P. **Butler**: The spectrum of Halley's comet. Provision was made for photographing the comet and its spectrum from the beginning of May at Fosterdown, Caterham. Exceptionally bad weather prevented observations until the end of the month, when photographs and visual observations of the spectrum were obtained on May 23 and 26. The photographs of the comet taken with a Dallmeyer lens, 6 inches aperture, 50 inches focus, show that the nucleus was at times multiple. Visual observations of the nucleus showed strong continuous spectrum with three bands in the yellow-green, green, and greenish-blue, having approximate wave-lengths 5635 (int. 7), 5165 (int. 10), 4737 (int. 7). The spectrum of the coma surrounding the nucleus consisted of these same three bands, without any indication of continuous radiation. The photographic spectra show only the brightest spectra features of the spectrum of the nucleus, the relative intensities differing widely from the visual intensities owing to the selective sensitiveness of the plates. The two most conspicuous bands are near λ 4737 (int. 10) and 3884 (int. 6), with fainter bands near $\lambda\lambda$ 4050, 4360, 5165, and 5635. Photographs obtained elsewhere at different times show differences in the relative intensities of the component bands. This has been ascribed to variations of atmospheric absorption. It may be noted, however, that before and after the transit of May 19 the aspect of the head would vary quickly; at one time the hotter side facing the sun would be best seen, at others the cooler portions away from the sun would be more prominent. Preliminary experiments show that by varying conditions of vaporisation the relative intensities of the carbon or hydrogen bands may be considerably modified, and it would appear that the changes observed in the cometary spectrum might be produced by some such difference of condition.—Dr. H. F. **Baker**: A geometrical proof of the theorem of a double six of straight lines.

EDINBURGH.

Royal Society, November 7.—Prof. Crum Brown, vice-president, in the chair.—J. D. Hamilton **Dickson**: A thermoelectric diagram from $-200°$ to $+100°$ C., based on the experiments of Sir James Dewar and Prof. Fleming. The platinum temperatures were first reduced to absolute scale. The observations of the electromotive force of each metal-lead couple were plotted against temperature, and the curves were drawn freehand with the greatest care through them. By finding the locus of the middle points of parallel chords, Mr. Dickson proved that the curves were all, with one exception, parabolas. The exception was in the case of antimony-lead, for which the curve was a hyperbola. In the majority of cases the parabolas differed from those obtained by Tait through the more limited range of temperature used by him and his students in the main fact that their axes were not perpendicular to the temperature axis. The "Tait lines," as it was convenient to name the lines of thermoelectric power, were not in these straight, although limited portions of them might be very nearly so. As was easily proved from the geometry of the parabola with inclined axis, each Tait line was a curve with two asymptotes perpendicular to one another. Of the metals investigated, gold, silver, zinc, and German silver followed Tait's rule, the thermoelectric powers referred to the lead line giving straight lines; but platinum, copper, cadmium, nickel, manganese, palladium, and aluminium gave for their electromotive-force curves parabolas with inclined axes. Similar results were obtained from recent observations published by Holborn and Wien, Barus, and from early observations by J. Murray and J. C. Young, working under Tait's directions.—Profs. Alex. **Smith** and A. W. C. **Menzies**: A dynamic method for measuring vapour pressures, with its application to benzene and ammonium chloride. A modified form of the isoteniscope, previously described, was used in determining the vapour pressures of these substances. The advantages of the new form of apparatus were that it could be used for high pressures, that the confining fluid could be reduced in amount, and that the thermometer was inserted directly in the bath with its bulb no longer in a region of varying pressure.—Profs. Alex. **Smith** and W. C. **Menzies**: A quantitative study of the constitution of calomel vapour. The object of the investigation was to find to what extent the vapour of calomel was dissociated, and the method was to measure the vapour pressures by means of the isoteniscope at various temperatures from 360° C. to 400° C. The results showed (1) that the vapour of calomel was composed wholly of mercury and corrosive sublimate, HgCl and HgCl being alike absent; (2) that calomel dissolves in mercury with a molecular weight corresponding to the formula HgCl; (3) that the isoteniscope may be used in the quantitative investigation of chemical problems.—Dr. R. A. **Houston**: The efficiency of metallic filament lamps. The results were obtained by means of a new method involving the examination with a thermopile and very sensitive galvanometer of the spectrum of the radiation transmitted by a water filter. The values obtained for the efficiencies of carbon, osmium, tantalum, and tungsten lamps as energy transformers were respectively 2·9, 5·2, 6·5, and 7·5 per cent.

PARIS.

Academy of Sciences, November 21.—M. Émile Picard in the chair.—H. Lorentz was elected a foreign associate in the place of the late Prof. Schiaparelli.—Lord Avebury was elected a correspondant for the section of anatomy and zoology, in the place of Sir Ray Lankester, elected foreign associate.—G. **Fayet**: The identity of the Cerulli comet with the Faye comet. The elements calculated for the two comets are nearly identical, the slight difference noted being probably due to the fact that the considerable disturbance of the orbit of the Faye comet caused by Jupiter in 1899 was only approximately allowed for.—C. **Popovici**: Observation of the Cerulli-Faye comet. Data are given for November 22.—G. **Tzitzéica**: A theorem of M. Darboux.—W. **Stekloff**: A new application of the method of development of fundamental functions.—Paul **Lévy**: The integrability of the equations defining line functions.—G. **Eiffel**: The resistance of rectangular planes struck obliquely by the wind. Experiments were carried out with a suction fan, using a 70 horse-power motor, giving an air current of 10 to 20 metres per second in a tube of 1·5 metres diameter. The results are given graphically in a series of curves.—Jean **Becquerel**: The reversal of the phosphorescence bands. Rubies and an emerald were used for these experiments at the temperature of liquid air. The reversal establishes a qualitative relation between the emission and absorption, and some quantitative relations are worked out.—R. **Jouaust**: The magnetic properties of iron at high frequencies. The iron was used in sheet form, the alternating current, produced by a Poulsen arc, having a frequency of 150,000 per

second. The losses observed are 20 per cent. higher than those calculated from J. J. Thomson's formula.—Frédéric **Reverdin** and Armand **de Luc**: The comparative nitration of mono- and dialkylated amines.—L. H. **Philippe**: The glucodeconic acids. The author has extended E. Fischer's synthesis of gluconose to the next higher homologue, glucodecose. In the present paper the preparation and properties of the glucodeconic acids are described.—G. **Friedel** and F. **Grandjean**: Anisotropic liquids. A discussion of the meaning of some experiments recently described by M. Mauguin on the optical properties of azoxyphenetol. The authors regard the term *anisotropic liquids* as being preferable to *liquid crystals*. Marin **Molliard**: The mode of action of the intensity of illumination in the formation of cleistomamic flowers.—P. A. **Dangeard**: A marine alga from the Concarneau Laboratory.—M. **Ringelmann**: Experiments on the yield of juice from the cider press.—Armand **Dehorne**: The coexistence of division and a subdivision of chromosomes in a quiescent state.—Paul **de Beauchamp**: A new gregarian of the genus Porospora.—A. **Gruvel**: The lampreys of the western coast of Africa and their commercial possibilities.—J. **Chatanay**: A remarkable anomaly of *Zonabris variabilis v. Sturmi*.—A. **Fernbach**: The biological degradation of the carbohydrates. Macerations of *Tyrothrix tenuis* act upon starch, maltose, dextrose, or saccharine, and dioxyacetone, glyceric aldehyde, and methylglyoxal have been recognised among the products of the reaction. Formaldehyde and acetaldehyde are also produced by this organism.—J. **Effront**: The action of the Bulgarian ferment upon proteid and amido substances. The Bulgarian ferment rapidly destroys albuminoid material, removing the nitrogen in the form of ammonia, and it is possible that the favourable action of the ferment in gastro-intestinal affections is due to this action instead of to the production of lactic acid.—P. **Chaussée**: The production of primitive thoracic tuberculosis in cattle by the inhalation of infinitesimal amounts of bovine tuberculous material. These experiments prove the possibility of direct infection of the lungs by the inhalation of minute proportions of tuberculous material. In all the cases the mesenteric and cervical ganglia were examined for tubercular infection with negative results.—Jacques **Deprat**: Seismic activity in southern Yun-nan in 1909.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 8.

ROYAL SOCIETY, at 4.30.—Colour-blindness and the Trichromatic Theory. Part II. Incomplete Red or Green Blindness: Sir W. de W. Abney, K.C.B., F.R.S.—On the Sensibility of the Eye to Variations of Wavelength in the Yellow Region of the Spectrum: Lord Rayleigh, O.M., F.R.S.—(1) Trypanosome Diseases of Domestic Animals in Uganda. IV. *Trypanosoma uniforme*, sp. nov.; (2) Trypanosome Diseases of Domestic Animals in Uganda. V. *Trypanosoma nanum*. (Laveran): Colonel Sir D. Bruce, C.B., F.R.S., and others.—Some Enumerative Studies on Malarial Fever: Major R. Ross, C.B., F.R.S., and D. Thomson.—On Hæmoglobin Metabolism in Malarial Fever: G. C. E. Simpson.—A Case of Sleeping Sickness studied by precise Enumerative Methods. Further Observations: Major R. Ross, C.B., F.R.S., and D. Thomson.—Enumerative Studies on *Trypanosoma gambiense* and *Trypanosoma rhodiense* in Rats, Guinea-pigs, and Rabbits; Periodic Variations disclosed: Dr. H. B. Fantham and J. G. Thomson.—The Life History of *Trypanosoma gambiense* and *Trypanosoma rhodiense* as seen in Rats and Guinea-pigs: Dr. H. B. Fantham.—Experiments on the Treatment of Animals infected with Trypanosomes, by means of Atoxyl, Vaccines, Cold, X-rays, and Leucocytic Extract; Enumerative Methods employed: Major R. Ross, C.B., F.R.S., and J. G. Thomson.

MATHEMATICAL SOCIETY, at 5.30.—(1) Properties of Logarithmico-exponential Functions; (2) Some Results concerning the Increase of Functions defined by an Algebraic Differential Equation of the First Degree: G. H. Hardy.—Optical Geometry of Motion: A. A. Robb.—(1) Note on the Pellian Equation; (2) A Property of the Number 7: T. C. Lewis.—On the Arithmetical Theory of Binary Cubic Forms: G. B. Mathews.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Magnetic Properties of Iron and its Alloys in Intense Fields: Sir R. Hadfield, F.R.S., and Prof. B. Hopkinson, F.R.S.

FRIDAY, DECEMBER 9.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The Determination of Selenographic Positions and the Measurement of Lunar Photographs. Fifth Paper: Results of the Measurement of Two Yerkes Negatives: S. A. Saunders.—Note on an Erroneous Formula employed in the Tables of the Four Great Satellites of Jupiter: R. A. Sampson.—On the Accuracy of the Positions of the Star Images in the "Harvard Sky": H. H. Turner.—On Multiple Solutions in the Determination of Orbits from Three Observations: C. V. L. Charlier.—Occultations of Stars observed during the Eclipse of the Moon, Nov. 16, 1910: Cambridge Observatory.—The Equatorial Current of Jupiter in 1886: A. Stanley Williams.—(1) Photographic and Visual Observations of Halley's Comet (1909c), Daniel's Comet (1909e), and Comet 1910a, made at the Radcliffe Observatory, Oxford; (2) Observations of Stars Occulted by the Moon during the Eclipse of Nov. 16, 1910, at the Radcliffe Observatory, Oxford: A. A. Rambant.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Recent Progress in Electric Lighting: Prof. E. W. Marchant.

MONDAY, DECEMBER 12.

ROYAL SOCIETY OF ARTS, at 8.—Industrial Pyrometry: C. R. Darling.

TUESDAY, DECEMBER 13.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Some Unexplored Routes between Angora and Eregli: R. Campbell Thompson.

ZOOLOGICAL SOCIETY, at 8.30.—Report of the International Commission on Zoological Nomenclature presented to the Graz Meeting of the International Zoological Congress, 1910: Dr. W. E. Hoyle.—On the Segmentation of the Occipital Region of the Head in the Batrachia Urodela: E. S. Goodrich, F.R.S.—On the Structure and Function of the Gas-glands and Retia Mirabilia associated with the Gas-bladder of some Teleostean Fishes, with notes on the Teleost Pancreas: Dr. W. N. F. Woodland.—The Mammals of the Tenth Edition of Linnæus: an attempt to fix the Types of the Genera and the exact Bases and Localities of the Species: Oldfield Thomas, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: Portland Cement, and the Question of its Aëration: H. K. G. Bamber.

FARADAY SOCIETY, at 8.—Separation of Oxygen by Cold: J. Swinburne, F.R.S.—New Apparatus for the Rapid Electro-analytical Determination of Metals: Dr. H. J. S. Sand and W. M. Smalley.

WEDNESDAY, DECEMBER 14.

ROYAL SOCIETY OF ARTS, at 8.—A New View of Roman London: Reginald A. Smith.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—Some Recent Developments in Condensing Plant: G. L. Kothny.

THURSDAY, DECEMBER 15.

LINNEAN SOCIETY, at 8.—Reports on the International Botanical Congress at Brussels, 1910: Dr. Otto Stapf, F.R.S., and others.—Non-calcareous Sponges from the Red Sea, collected by Mr. Cyril Crossland: R. W. H. Row.—Comparative Anatomy of Leaves of Veronica: R. S. Adamson.

ROYAL SOCIETY OF ARTS, at 4.30.—The Taj Mahal and its Relation to Indian Architecture: R. F. Chisholm.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Submarine Cables for Long Distance Telephone Circuits: Major W. A. J. O'Meara, C.M.G.

FRIDAY, DECEMBER 16.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Production of Castings to withstand High Pressures: Prof. H. C. H. Carpenter and C. A. Edwards.—The Constitution of Troostite and the Tempering of Steel: Andrew McCance.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Mathematical Deduction of the most Economical Ratio of Reinforcement for Reinforced-concrete Structures: R. N. Mirza.

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THURSDAY, DECEMBER 15, 1910.

THE CAVENDISH LABORATORY.

A History of the Cavendish Laboratory, 1871–1910. Pp. xi+342. (London: Longmans, Green and Co., 1910.) Price 7s. 6d. net.

THE occasion of this book is the fact that on December 22, 1909, Sir J. J. Thomson completed the twenty-fifth year of his tenure of the Cavendish professorship of experimental physics in the University of Cambridge. As the editors state in their preface, the suggestion was made by some of the professor's immediate colleagues that the event should be celebrated in some way which would commemorate a tenure so long and so full of achievement. Hence this history of the laboratory over which Thomson has presided for the greater part of its existence.

The general plan has been to divide the time covered by the history into periods, each of which has been treated by an author intimately acquainted with its events. The result is a marvellously interesting set of records. If the history had been written by one hand only, it would no doubt have been more continuous and concise, but it would have lost materially in charm and in value. As it is, the reader can well imagine himself in the company of a number of friends who have played important parts in a campaign, and who now relate in turn what they did and saw. And, of course, the campaign has been full of important events. Every student of physical science has been aware in a general sense of what he owes to the forward movements made in the Cavendish Laboratory. Yet in all probability even those who are best acquainted with the history of modern physics will find evidence in this volume of a greater debt than they had imagined. The list of papers published from the laboratory, a list to be found at the end of the book, is simply astonishing; it shows important additions made to every branch of physics. The names of the authors and workers in the laboratory include those of nearly all the best-known English physicists of to-day, and of many from abroad. In their contributions to the book itself the various writers give us something which is welcome and valuable. They bring about us the atmosphere of the place. We see the continual and unwearying struggle with the difficulties on that road which Maxwell and Thomson and their fellow-workers felt sure was the road to success. We realise their hopes and disappointments and successes as they try one line of attack after another; we share in the triumph of the final unearthing of the electron and in the rapid progress which followed on that unique discovery.

The story of the building of the laboratory is told by Fitzpatrick and Whetham, who also write of the commencement of instruction in practical physics at a time when there was hardly a precedent in such work to serve as guide. Schuster describes the period of Clerk Maxwell, whose commanding genius set a standard for his professorship and his laboratory. Two passages of Maxwell's writing are quoted repeatedly in the book; they have clearly been acknowledged as directions to his successors. The one is drawn from his inaugural address, and defines the aims and methods of experimental inquiry. The other is a flash of insight, the product of his brilliant work on electromagnetic theory. He saw that the phenomena of the electric discharge when better understood would "throw great light on the nature of electricity as well as on the nature of gases and of the medium pervading space." It is remarkable how fully this has been realised and how each one of the three questions which he mentions has since been illuminated by investigations in the direction which he points out. Best of all, a great part of this work has been done in the Cavendish Laboratory under the guidance of the man in whose honour this book has been written. Glazebrook writes of the fine work which was done under Lord Rayleigh, work characterised by Rayleigh's recognition that the accurate determination of electric standard had become a pressing matter. In 1884 Thomson succeeded Rayleigh. Thomson gives, in a chapter which is all too short, a survey of the twenty-five years that followed. It is naturally one of the most interesting chapters in the book. We read his own account of his work and of the gradual evolution of his principal discoveries, of his fellow-workers, of the system of teaching at the Cavendish, and of the classes that grew so rapidly under his rule.

No doubt Sir Joseph Thomson could hardly be trusted to write the full history of the doings in the laboratory during his own occupation of the Cavendish chair. That has been done by four men—Newall, Rutherford, C. T. R. Wilson, and Campbell, each closely concerned in the inquiries of the period which he has discussed. Newall describes the years between 1885 and 1894, when the interest centres round the general attack on the problem of the electric discharge. Rutherford writes of the three years of intense activity, 1895–8, when the position was stormed, the electron was captured, and Röntgen's X-rays supplied such a ready means of investigating phenomena in which the electron was concerned. C. T. R. Wilson describes the events of 1899–1902, including the elaboration and use of the condensation method which he himself did so much to perfect. Campbell shows the attempts to apply the new knowledge to "the fundamental problem of modern physics, the relation between electricity and matter." He gives also an interesting sketch of the curious and difficult situation into which the knowledge has led us. Finally, Wilberforce writes of the development of the teaching of physics with a keen sense, both of the difficulties of the art and of their compensating humour.

Taking the book as a whole it is, in the first place, a very charming testimony to the regard which the workers in the Cavendish entertain for Sir Joseph Thomson. He must be a happy man to note the generous and affectionate appreciation so widely evident in the book. In the second place, it will be of perpetual interest to students of physics as a record of the inner life of the Cavendish during a strenuous and prolific period. It is still more. It is practically the history of the development of laboratory teaching and organised research in England, so far as physical science is concerned. In many ways it is reassuring.

If we consider the work done, the number of first-class investigations, and the importance of the deductions made from them, we have no reason to be ashamed of our country's contribution to the general advance. We can be proud that so many students have proved their worth in the Cavendish and left it to fill important positions elsewhere, proud, too, that students from abroad have so freely acknowledged their debt to its spirit of enthusiasm and generous comradeship in research. It is true that the book leads us to consider the general question of physical research in England, and that we then find conditions which are not completely satisfactory. We have still to fight for the recognition of the value of such research, and we must in some way improve on the disjointed nature of the career of the research student. Too often his only reward is a teacher's position in which he finds difficulty in exercising the powers he has educated. But we cannot enter on the consideration of such questions now; we are only concerned with a book which fulfils admirably the purpose for which it was written.

A NEW BOOK ON REPTILES.

Reptiles of the World. Tortoises and Turtles, Crocodilians, Lizards, and Snakes of the Eastern and Western Hemispheres. By R. L. Ditmars. Pp. xix+373+87 plates. (London: Sir Isaac Pitman and Sons, Ltd., 1910.) Price 20*s.* net.

PRIMARILY intended as a general survey of the reptiles of the world treated in a popular manner, the handsome volume which has just appeared simultaneously in this country and in America, will prove of special value to all who keep these animals in captivity. The name of Mr. Ditmars is a guarantee of accuracy and originality in the treatment of a subject in which he excels over all others. The success with which he has managed for some years the largest collection of living reptiles in existence, viz., that in the New York Zoological Park, is well known. From early boyhood his enthusiasm for reptiles, especially snakes, has led him to study the habits of these reptiles, so repulsive to many, even among educated people, and his house has always been the headquarters of an extensive collection of snakes, large and small, innocuous and venomous.

The information he gives us is therefore thoroughly trustworthy, unlike what we find in so many so-called popular works, and we strongly recommend this book to amateurs who keep reptiles in captivity, as well as to those whose duty it is to look after them in public menageries.

The American species, of course, receive the lion's share in a treatise emanating from America, and in a publisher's note to this English edition the reader is asked to bear in mind that the species referred to by the author as musk turtles, mud turtles, pond turtles, box turtles, &c., are known in this country as tortoises, the term turtle being restricted to the marine, and sometimes a few of the larger river species. The reviewer would express the regret that the term Terrapin, used for some of the fresh- or brackish-water tortoises in America, has not been made to include these intermediate forms, which are neither true tortoises nor turtles. Further, the name sand lizard, applied to *Acanthodactylus boskianus* (p. 38) is misleading, as by sand lizard every English reader would understand our *Lacerta agilis,* which has always been known under that name. As is to be expected from an author who is not exactly a systematist—some may say all the better for the treatment of the subject in a popular style, the information as to the relationships and distribution of the animals dealt with, and the number of species in each genus, is not always quite up to date. Thus we notice that among the Chelonians the Carettochelydidæ are still included among the Pleurodirans, to which they were tentatively assigned before the skeleton was known, although it is now established that they belong to the Cryptodirans, in the neighbourhood of the Trionychidæ. The common snapping turtle is said to extend southward to Ecuador, whence it was first reported by the late Prof. Peters; but the reviewer was able to show, many years ago, that the snapping turtle of Ecuador is a distinct species, identical with the Central American *Chelydra rossignoni.* No allusion is made to the allied genus discovered a short time ago in New Guinea.

On the whole the author has adhered to the classification and nomenclature used in the British Museum catalogues (1885–96), but he has departed from the latter in the case of many North American types, which causes some confusion and a lack of harmony in the systematic treatment of the subject.

These are, however, very trivial defects. The great value of the work lies, as we have said, in the matter relating to the habits of the reptiles, both wild and in captivity, a subject on which the author is *facile princeps.*

The varied contrivances by which reptiles secure their food, produce and rear their young, harmonise with their surroundings, &c., are fully dealt with, and in a thoroughly original manner. The size to which the largest crocodiles and snakes grow is also discussed, and only trustworthy records are adduced. The largest crocodile measures 30 feet, so does the largest python, the anaconda rather more than 25, the *Boa constrictor* only 11; but it must be borne in mind that the name *Boa constrictor* is often applied to pythons in menageries and by colonists in Africa.

On the subject of snakes swallowing their young, it is important to have the opinion of an observer of such wide experience as Mr. Ditmars. "The story of the female snake swallowing her young in time of danger," he says, "is purely fallacious. It has originated from observations of cannibal species making a meal of young reptiles" (p. 203). Apropos of cannibal species, we wish to direct attention to the important experiments made on the king snake (*Coronella* or *Ophibolus getulus*) of North America, a harmless species, which is apparently immune to the venom of such deadly pit-vipers as the rattlesnake, the copperhead, the mocassin, and the South American Lachesis, whilst it usually dies within an hour if injected with the poison of the old-world cobras.

Mr. Ditmars's observations and experiments on chameleons and other lizards with changing hues have

convinced him that the colour-changes which these reptiles undergo with such rapidity are not, as often believed, in harmony with their surroundings, but are regulated chiefly by light, temperature, excitement, fright, or health. We here reproduce a partial list of these experiments on the common chameleon:—

Specimen A. Placed in the sunlight so that but one side of the lizard was exposed to the rays.

Specimen B. Placed in the sunlight at an angle to entirely suffuse the reptile with the rays.

Specimen C. Placed in a dark box; temperature, 73° F.

Specimen D. Placed in a dark box; temperature, 50° F.

After fifteen minutes, the following results were noted:—

Specimen A. Was a dark brown on the side that had been exposed to the sun; the shadowed side was a pale brown, mottled with green.

Specimen B. A uniform brown, deeper than the dark side of specimen A.

Specimen C. When the cover of the box was drawn the lizard emerged in a brilliant coat of green.

Specimen D. Crawled sluggishly from the cold quarters. Its colour was a uniform slaty-grey.

One curious effect of sunlight and shadow was noticed. A specimen had been basking under a coarse wire grating. Becoming frightened at the approach of the observer, it changed its position. On the dark brown body was what had been the shadow of the grating, brilliantly imprinted in pale yellow. Within half a minute this pattern had entirely faded.

The book is copiously illustrated with reproductions of photographs taken by the author from living specimens, and most of them are of high excellence. In some cases, however, the reduction is too great, such figures as those of the European lizards and the glass-snakes and slow-worm (plates xxxi*a* and xxxvii.) being, from this cause, practically useless. The snake figured on plate lxxvii as *Cerastes vipera*, and stated to measure about two and a half feet, is a hornless *Cerastes cornutus*. The author appears to be unaware of the existence of such hornless specimens, otherwise he would not have written (p. 328) that it is "impossible to mistake the horned viper," and that *C. vipera* is, but for the absence of horns, much like *C. cornutus*. A three-colour process figure of the rhinoceros viper, "the most beautifully coloured of all poisonous snakes," is given as a frontispiece.

G. A. B.

THE CALCULUS OF VARIATIONS.

Leçons sur le Calcul des Variations. By Prof. J. Hadamard. Tome premier. Pp. viii+520. (Paris: A. Hermann et Fils, 1910.) Price 18 francs.

NO one could be more competent than M. Hadamard to deal with the calculus of variations, and when this work is completed it will be a most valuable exposition of the present state of the subject. It is significant that in the first lines of his preface the author expresses the view that the calculus of variations is only a first chapter of the functional calculus (*calcul fonctionnel*) of Volterra, Pincherle, &c., and he gives, in fact, a short chapter on this new theory (pp. 281–312). But the analysis, in this volume, is mostly of a more familiar kind.

In fact, the first step in any actual case that naturally presents itself is still the classical one of Lagrange, by which we obtain a differential equation, or a set of differential equations. For simplicity, suppose the varied integral to be $\int f(x, y, y')dx$, then the differential equation is of the second order, and its solution is said to form a family of extremals. Supposing that the limiting values of x and the corresponding values of y to be given, then in the general case we may expect to find one extremal satisfying the terminal conditions. But it by no means follows that this curve really makes the given integral a maximum or minimum; an example due to Scheeffer is given on p. 45, which brings out the point very clearly. In this case the extremal found from the differential equation is $y=0$, and the corresponding value of the integral is 0; nevertheless, analytical curves can be drawn, as close as we please to $y=0$, which make the integral negative.

In any case, a solution obtained from an extremal is only a relative one; that is, the extremal gives a maximum or minimum value of the integral relatively to adjacent paths. And here it is important to define what we mean by *adjacent*, a fact first fully realised by Weierstrass, whose definition of adjacency of the *p*th order is given on p. 49. We may have, for instance, two curves each passing through the terminal points A, B, and as close together as we please, but one may be of continuous, the other of discontinuous curvature. Now, if we have a varied integral involving higher differential coefficients than y', we must exclude curves of discontinuous curvature, otherwise the problem becomes meaningless, and similarly in other cases.

After the limitations of the problem have thus been touched upon, book ii. deals with the first variation, and the conditions of the first order, including variable limits. Among other interesting points we have Weierstrass's transformation to homogeneous coordinates, a discussion of foci (points on the envelope of a family of extremals), and two very useful innovations due to M. Hadamard. If $\int f(x, y, y')dx$ is the varied integral, the *figurative* is defined to be the curve $f(x, y, y')=u$, in which u, y' are regarded as current coordinates, and x, y as constants. The *figuratrix* is defined as the polar reciprocal of the figurative with respect to $x^2+y^2=1$. By means of these curves the author is able to put various analytical conditions into a vivid geometrical shape. It may be added that book ii. contains the discussion of various classical problems, such as brachistochrones, least action, the Hamiltonian equations of dynamics, &c.

Book iii. introduces the second variation, and goes more deeply into the methods of Weierstrass, as well as those of Jacobi, Clebsch, Hilbert, Kneser, and others. We arrive ultimately at a statement, in various forms, of sufficient conditions for a minimum (pp. 389, 397), deduced mainly from the properties of a pencil of extremals, and a brief discussion of the necessary conditions, illustrated by examples (chapter iii.). The remaining chapters deal with variable limits, discontinuous solutions, Osgood's theorem in

connection with the strict minimum, and various other topics. Finally, there is a note on implicit functions.

Various interesting special theorems occur, by the way; as an instance, we have the theorem that if y vanishes for $x=a$ and $x=b$, the integral

$$\int_a^b \{(a-b)^2\left(\frac{dy}{dx}\right)^2 - \pi^2 y^2\} dx$$

is never negative.

It will be seen that this treatise is more for the advanced student than for the beginner; in fact, as the author expressly takes the theory of the differential and integral calculus for granted, the reader should be prepared with a good knowledge of analysis, including function-theory. In any case, the subject is intrinsically difficult, owing to the vagueness of the data when the problem is put in its general form; it is rather a matter of surprise that so much has been done, without unduly restricting the nature of the functions involved.

In conclusion, it should be stated that the treatise is based upon a course of lectures at the Collège de France, and that the *redaction* has been carried out by M. Fréchet, to whom M. Hadamard makes his acknowledgments.

G. B. M.

HYDROELECTRIC ENGINEERING.

Hydroelectric Developments and Engineering. A Practical and Theoretical Treatise on the Development, Design, Construction, Equipment, and Operation of Hydroelectric Transmission Plants. By F. Koester. Pp. xxv+454. (New York: D. van Nostrand Company; London: A. Constable and Co., Ltd., 1909.) Price 21s. net.

HYDROELECTRIC power plants do not call for the same attention in this country as in America and on the European continent. Yet what English engineer who has visited such installations has not a store of vivid recollections and happy experiences? The mountains and the forests, the streams and the waterfalls—for the generating stations of hydroelectric plants are usually away out among the beauties of nature—all bring back memories of pleasant tours and the like, whilst so far from destroying the attractiveness of their surroundings by harnessing nature's forces in this way, the author of the present work maintains that the scenery has at times been made more interesting, when proper attention has been paid to the architecture and situation of the buildings. This opinion is well upheld by many of the splendid photographs reproduced so well in this large volume.

The title of the book, however, is certainly ambitious, and, criticised from this point of view, we fear that the treatment on the whole is too general and descriptive, even to the point at times of being meagre, to be of great service to those directly connected with hydro-power plant installations. This will be further understood from the table of contents, which comprises chapters on dams, headrace, penstocks, power plant, mechanical equipment, electrical equipment, electrical transmission, substations, line protection, and a long list of developments, any one of which could occupy such a volume by itself. Hence it is almost inevitable that only a bird's-eye view could be given when all these subjects were brought within the compass of one book. It may be recalled that this popular mode of treatment appears to meet with more favour in America than in countries this side of the Atlantic. With this one reservation, however, we have nothing but praise for the general excellence of the book, the care devoted to its arrangement, and the high quality of its illustrations.

To show that the writer is well up-to-date, it is only necessary to refer to a few of the new features in hydroelectric developments which are dealt with in their respective chapters:—Airshafts and equalising chambers in connection with pressure tunnels; seamless welded, flangeless, telescoping penstocks to facilitate shipment and to eliminate expansion joints; siphon system, in contradistinction to the inverted siphon; impulse wheels with draft tubes and multiple, non-water-wasting nozzles; compound turbine on a single shaft, the discharge of one being the supply of the other; rapid and complete turbine tests by certain methods and autographic recording device; 30,000-volt generators and their efficient protective devices against lightning. Unique combination of single and three-phase high-tension transmission systems from three-phase generators; wagon-panel switchboard systems; segregation and decentralisation of switchboards; continuous water-flow grounders and horngaps with micrometric setting. Two-legged transmission towers and line-crossing protection.

At the end of each chapter is appended a bibliography of works and papers to which the student may turn for further information; this compilation is by no means the least valuable feature of the book.

Occasionally the author's treatment includes matter where his judgment seems to have been less sound. Thus in discussing electric generators, he states there are three types—the inductor, the revolving armature, and the revolving field. But surely there is no reason for treating all these at equal length?—indeed, little harm would have been done if the discussion of the first two types had been omitted completely in describing modern high-tension machines, unless, of course, the author intended to enter into the province of the designer in order to bring out certain advantages in the older types which have recently become prominent. Nor is sufficient attention paid to the development of high-speed water-turbine sets of large output. It would have been well to have supplied a table giving outputs and speeds of modern turbine sets for the various classes of turbines.

Here and there an error has been allowed to remain in the text, whilst at times important questions, such as the effect of capacity in transmission lines, have been omitted.

Following a very useful and well-written chapter on line protection (lightning arresters), the last section of the book is devoted to a detailed description of eight modern American and European hydroelectric developments, which serve well to show the immense advance made in water-power installations during recent years.

STANLEY P. SMITH.

THE ORIGIN OF COAL.

Die Entstehung der Steinkohle und der Kaustobiolithe überhaupt. By Prof. H. Potonié. Fünfte Auflage. Pp. xi+225. (Berlin: Gebrüder Borntraeger, 1910.) Price 7.80 marks.

THE study of the probable mode of formation of coal and kindred substances has for many years engaged the attention of Prof. Potonié, who, as palæobotanist in the University of Berlin, and also as a member of the Geological Survey of Prussia, has had exceptional opportunity for such study, both in the cabinet and in the field. At the York meeting of the British Association in 1906, he laid before the Botanical Section his views on the origin of coal, and the following year issued the fourth edition of his little work, "Die Entstehung der Steinkohle, u.s.w."—an octavo of only forty-seven pages, which was briefly noticed in NATURE (vol. lxxviii., p. 86). In the new edition, recently published, the work has been considerably enlarged, and the title so modified as to indicate that it deals with the origin of caustobioliths generally.

Under this term *caustobioliths* are included all those rocks or mineral substances which are, directly or indirectly, of organic origin, and are combustible, whilst such organic rocks as are incombustible, like chalk, are distinguished as acaustobioliths. In order to explain the origin of the fossil deposits, the author has wisely given much attention to the corresponding recent formations, or what may be reasonably regarded as such. Three great groups of caustobioliths are recognised. In the first place, there are the rocks called *sapropelites,* formed from organic slime, or sapropel, resulting from the partial decay of aquatic organisms and their products in stagnant water. When the sapropel, in a sub-fossil state, becomes gelatinous, it is distinguished as saprocoll, whilst the Tertiary forms are described as saprodil, and the older varieties as sapanthracon. It is a disadvantage that the work is rather heavily weighted with an unfamiliar terminology, but it must be conceded that most of the terms are expressive, and in many cases undoubtedly convenient.

Cannel coal, boghead mineral and many so-called bituminous shales are regarded as sapropelites, whilst petroleum is considered by Prof. Potonié to be a product of the natural distillation of deep-seated sapropel rocks, which have been exposed to heat and pressure during processes of mountain-building.

Another great group of caustobioliths is formed by the humus rocks, which result from the accumulation of the remains of land-plants and bog-plants. This important class contains not only many brown coals, but our ordinary coals and anthracites. Whilst sapropel rocks, generally present a dull surface, or a silky lustre, and when heated yield much gas, the humus rocks, or at any rate those of Palæozoic age, are usually lustrous and yield a smaller proportion of gas. Coal which shows an alternation of bright and dull layers is regarded as a mixed caustobiolith, derived partly from humus, partly from sapropel.

To Prof. Potonié common coal is a rock which in most cases has been formed where it is now found, mainly by the fossilisation of deposits of peat, often in far-stretching swamps. Considering the modern tendency, especially in France, to regard most coal as a substance of allochthonous formation, it is interesting to find a distinguished specialist upholding the view of "growth in place," which until recently has been so much favoured in this country.

Peaty deposits, though not formed of transported material, may exhibit stratification, and humus matter may be partially dissolved in water and precipitated in layers. The coal-forming peat was probably in a pulpy condition. In certain cases, the author suggests that the appearance of stratification is explicable as the result of pressure acting in a direction at right angles to that of the lamination. Prof. Potonié holds that the flora of the coal measures indicates a tropical climate, and cites instances of the extensive growth of peat in tropical swamps, as in the fens of Sumatra, described by Dr. S. H. Koorders.

Distinct from both the sapropelites and the humus rocks is a small group of caustobioliths called *liptobioliths,* of which amber and pyropissite are examples. The liptobioliths consist chiefly of resinous and waxy substances, which by their resistance to decomposition are left after the decay of the other parts of the original organism.

Throughout the work the author gives numerous references to original authorities, but unfortunately in most cases without sufficient detail, the reference being usually limited to the name of the author and date of publication, such as "vergl. Uthemann, 1892." The student seeking further information would be grateful for a little more definite guidance.

F. W. R.

THE VOICE AND SINGING.

(1) *The Brain and the Voice in Speech and Song.* By Prof. F. W. Mott, F.R.S. Pp. xi+112. (London and New York: Harper and Brothers, 1910.) Price 2*s.* 6*d.* net.

(2) *The Abuse of the Singing and Speaking Voice: Causes, Effects, and Treatment.* By Prof. E. J. Moure and A. Bowyer, Fils. Translated by Macleod Yearsley. Pp. xi+130. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1910.) Price 2*s.* 6*d.* net.

(3) *The Voice. An Introduction to Practical Phonology.* By Dr. W. A. Aikin. Pp. ix+159. (London: Longmans, Green and Co., 1910.) Price 7*s.* 6*d.* net.

THERE are now many manuals dealing with the voice and with the management of the voice and singing. These are unequal in value, more especially as regards the description of the anatomy and physiology of the organs of voice and speech, and not unfrequently the writer strongly advocates a view peculiarly his own, and on which he founds his method of training. It is therefore of importance to have a description of the organs concerned in voice

and speech from the hand of an experienced physiologist, who is at the same time sympathetic with music and with the arts of speaking and singing. This we have in Dr. Mott's admirable little book (1). Nothing could be better than the description he gives of the whole mechanism, and in language that any intelligent person can understand. In particular, and as one would expect from a distinguished neurologist, Dr. Mott shows the intimate relations of the organs of voice and speech to the brain centres of hearing and of motion, both as regards the delicate movements of the mechanism of voice and of articulation, and as regards posture and other bodily movements. Teachers of the art of voice production, as in singing or in the articulation of words and sentences in public speaking, know little of this side of their subject, and we feel sure that much of Dr. Mott's information will be to them a revelation. A study of his book will in some respects modify their mode of teaching.

(2) Messrs. Moure and Bowyer's book is of a different character. It deals with voice production in singing, but more especially with the serious mistakes that may be made by methods of teaching, or by the strain put on voices by singers themselves, that cannot fail to injure the vocal apparatus. We would recommend that a student should, in the first instance, carefully study Dr. Mott's book, and then take up that of the French authors. In the latter there is first an interesting historical sketch of the teaching of singing, from the time of the Romans onwards. The church was the first educator of singers, to meet the requirements of the plain chant. Trills, tremillos, and shakes by and by embroidered the tones, and it is curious that for many years falsetto voices were in great request. The invention of the madrigal in the sixteenth century enriched vocal music and made greater demands on performers. Thus much was done before a physiological basis was laid by Garcia, after the revelations made to him by his invention of the laryngoscope.

The description of the mechanism is not so thorough in the French book as that given by Dr. Mott, and it may give some superficial if not erroneous notions. The portion on the registers is well done, and more especially the description of the mixed or middle register. The chapter on "Vocal abuse" gives much valuable information. Both teachers and singers often forget that there should be a physiological harmony between different parts of the vocal apparatus. Pulmonary capacity, muscular power, the dimensions and delicacy of structure of the vocal cords, are all more or less related. Strong and sudden expiratory efforts made with the view of increasing the volume of the voice may injure delicate cords. A light tenor may make the mistake of trying to do what only a strong tenor can accomplish, or the tenor may even imagine he is a baritone. It is true that no laryngoscopic examination can enable a master to determine what his pupil is capable of doing, but a few trials, cautiously carried out with such solos for various voices as are given in detail on p. 104, would soon settle the question. Singers may also injure their voices by frequent displacement or change in the range of their voice. The same baritone in some circumstances may have to sing on successive days, or even on the same day, as a deep baritone or a high baritone of the Verdi type. Modern composers, and especially Wagner and his followers, have injured many voices by the demands they have made, as, for example, in *Tristan and Yseult*. They have been called "the executioners of the voice." Some singers never learn properly how to breathe, and by taking in too large a volume of air and expelling it with violence, by "bellowing," in fact, they may even produce emphysema of the lung. The chest voice is difficult to manage, and it may be much injured, by welding two registers, and thus destroying purity of tones. The scales showing the range of the registers on pp. 80–81 are very instructive.

There is an admirable chapter on some of the pathological effects of abuse. We find also an appendix showing the vocal ranges of varieties of voices, such as strong tenors, opera tenors, opera-comique tenors, baritones, high baritones, or Verdi baritones, basses, basso cantando, basso profondo, contralto, high soprano, mezzo-soprano, and dramatic soprano, and, to add to the interest of the list, the names of many of the distinguished artists of their day are given. The authors also point out, and illustrate by portraits, the relation that often exists between the physical appearance of the singer and the range and quality of the voice. There are some signs of haste in the translation; p. 15, line 4, should not "cause" be case? Second sentence on p. 21 not clear. It is difficult to understand the portion of the sentence at the top of p. 42. At middle of p. 42 insert "if" before he. As we have already indicated, the French Book is the complement to that of Dr. Mott, and both taken together leave little else to be written on the subject.

(3) This book is an admirable account of the mechanism of both speech and song. There is a full description of the physiological mechanism concerned in the formation of vowel tones and the sounds of consonants. The action of the vibrators (the vocal cords) and the management of the resonator (the cavities of the pharynx, mouth, nose, &c.), is illustrated by exercises which a reader can readily follow, and the rules to be attended to in the management of the breath are given with physiological explanations. Two notable features of the book are a pronunciation chart showing methods for the practice of English pronunciation, and figures termed by the author "Song diagrams," showing the capacity of the various kinds of voices, from deep bass to high soprano. Composers would do well to study the figures on pp. 138, 139, and 140, where they would see at once the exorbitant demands on the voices of great operatic singers made by certain composers, notably by Wagner and even by Beethoven. The effect of the prolongation of very high tones may be brilliant and striking, but their production must cause, in many cases, serious tear and wear to a fine voice. As a truly scientific exposition, dealing with a subject that has an important practical aspect, Dr. Aiken's book is to be strongly recommended.

John G. McKendrick.

OUR BOOK SHELF.

Die Wissenschaftlichen Grundlagen der analytischen Chemie. By W. Ostwald. Fünfte Auflage. Pp. xii+233. (Leipzig: W. Engelmann, 1910.) Price 8 marks.

THE appearance of a fifth edition of this well-known book affords gratifying evidence of the widespread recognition that the study of analytical processes from the theoretical point of view is a necessary adjunct to the practical work of the laboratory. At the same time, the continued demand for a book of this character is a striking testimony to the general utility of the ionic hypothesis in the consideration of the problems of analytical chemistry. In spite of the many attacks, persistent and vigorous, which have been made upon the theory of Arrhenius, it has to be admitted that its position as a working hypothesis is stronger to-day than it was at the time of issue of the first edition of this volume.

The changes to be found in the new edition are comparatively few. The principal novelty consists in a slightly modified treatment of the theoretical portion as a result of the introduction of the view that the stochiometric laws are, in a certain sense, a consequence of the methods which are employed for the preparation and identification of compounds. In this connection the conception of *phase* is introduced, and since a phase may be either a pure substance or a solution, the problem of differentiating between these two classes is obviously one which falls within the sphere of analytical work.

Little need be said of the section dealing with the applications of the ionic theory to specific chemical reactions. In the explanation of the action of the indicators used in acidimetry, it is now admitted that the indicator ion has probably a different structure from that of the non-ionised indicator molecule. Few changes have, however, been found necessary as a result of recent work, and the characters are retained which have earned for the book the right to be counted amongst the classics of the literature of analytical chemistry. H. M. D.

The "Wellcome" Photographic Exposure Record and Diary, 1911. Pp. 280. (London: Burroughs, Wellcome and Co., n.d.) Price 1s.

THIS little pocket-book is a veritable *vade mecum* of photography in tabloid form, and while the present writer never wishes to be without his copy when out with his camera, he is sure other workers, when they become acquainted with the contents of these pocket-books, will express the same sentiments.

There is no necessity to recapitulate in detail the literary portions of this book, but suffice it to say that they are of a very interesting and useful character, and besides dealing with the technical difficulties of exposure, development, &c., and colour photography, they include directions concerning negative-making, tank or stand developing, printing, toning, intensifying, and so on. In addition to the portion devoted to the recording of negatives exposed, there is ample room for memoranda to replace the use of an ordinary notebook. An important feature is the simple and effective exposure calculator attached to the inside of the cover, the correct exposure being read off under all conditions of light and subject by a turn of the scale. For this issue, this calculator is rendered even more simple for those who always employ plates or films of one speed. By the insertion of a special disc, which may be obtained gratis from the publishers, the exposure can be read off at a glance for any stop. This special disc will be particularly useful to those who expose yards of film in their Kodaks or other hand cameras.

It should be remembered that three editions of this "Record and Diary" are published, with corresponding data for the northern hemisphere and tropics, the southern hemisphere and tropics, and the United States of America. Handy in form, and bound in a neat green cover, it will find favour with most photographers.

Reason and Belief. By Sir Oliver Lodge. Pp. xiv+212. (London: Methuen and Co., Ltd., 1910.) Price 3s. 6d. net.

THIS is a contribution to the literature of reconciliation. The science and religion of the nineteenth century were hopelessly at variance, chiefly in consequence of the latter's claim to pronounce in matters of cosmology (*e.g.* Mr. Gladstone's "Impregnable Rock of Holy Scripture"). But the conditions are now different. Religion is being regarded as "an attitude of the soul to all that it knows of cosmic law"—in Myers's phrase—rather than as a matter of dogma; and science, also, is learning humility. Crude materialism is seen to be no complete solution of the riddle of the universe, for we do not know what "matter" is. Moreover, psychology is bringing to light certain phenomena which orthodox scientific theories do not seem to cover. The time, therefore, is ripe for a *rapprochement*; and among leaders of thought on the scientific side of the reconciliation movement, Sir Oliver Lodge is by far the most eminent and the most influential.

Man is a being who is temporarily clothed in matter, for purposes of education. He has lived before birth, and will live after "death," in modes only dimly conjecturable at present. If so, what difficulty is there in supposing that an exceptionally great and loving spirit, seeing the race's need, may voluntarily take a body of flesh, in order to teach his similarly incarnated brother spirits? This shows the way to a reconciliation of reason and belief on a cardinal doctrine of Christianity.

The volume is enriched with apt quotations from many sources—Wordsworth, Browning, Tennyson, Swinburne, Myers, Francis Thompson, &c. Its style is popular and clear, but the thought throughout is deep and suggestive. The latter part has an illuminating chapter on the scope of science, and also deals with the teaching of the Old Testament in the light of evolution, and with anticipated criticism. J. A. H.

Altitude Tables, computed for Intervals of Four Minutes between the Parallels of Latitude 0° and 30° and Parallels of Declination 0° and 24°, designed for the Determination of the Position-line at all Hour Angles without Logarithmic Computation. By F. Ball. Second edition. Pp. ix+245. (London: J. D. Potter, 1910.) Price 15s. net.

THE appearance of a second and improved edition of these tables is welcome on several grounds, but mainly as an indication of increasing accuracy in nautical calculations. We hope, too, that the demand for such tables may be regarded as a proof of the growing popularity of the method of determining the position of a ship at sea proposed by Captain Marcq St. Hilaire, of the French Navy. This method, though theoretically superior to that of finding the Sumner lines by the ordinary process, has not been generally adopted, on account of the slight increase in the computations required. Seeing that in the St. Hilaire method, the observations may be made at any time with equally good and consistent results, whereas in the ordinary method, observations taken near the meridian may have to be repeated nearer the prime vertical, the objections that have been alleged against the newer method on account of the length of the

observations ought not to be allowed to prevail. The sailor expects to find tables at hand that shall curtail the arithmetical processes to a minimum, and these tables, the main feature of which is to give readily and accurately, at sight, the altitude of the sun or of stars within the ecliptic limits, at least in the more frequented latitudes, will remove one of the objections that have been urged.

Other tables suggested by experience have been added in this edition in order to increase its utility and avoid the necessity of further reference. With these tables and a nautical almanac, it is said that the navigator can complete his task. We would, however, allow him a book of logarithms, for the tables given here are too restricted to serve any useful purpose. One might need to check the accuracy of some of the quantities supplied, though we have no reason to doubt the general accuracy of the tables, for which Dr. Crommelin and some of the staff of the Royal Observatory are responsible.

Metallography Applied to Siderurgic Products. By Humbert Savoia. Translated by R. G. Corbet. Pp. xii+180. (London: E. and F. N. Spon, Ltd., 1910.) Price 4*s*. 6*d*. net.

THE Italian original of this little book was obviously intended to bring the more essential parts of the metallography of iron and steel within the reach of Italian metallurgists, but what motive there can be to justify the translation into English of such an elementary compilation it is not easy to understand, particularly as satisfactory original works in our own language are now available. In the book as it stands the feats of the author are largely disguised by the achievements of the translator, who appears to have invented an entirely new nomenclature not only for purely metallographic terms but for well-known and widely-used technical words. That the translator disclaims technical knowledge of the subject-matter of the book and begs for indulgence in regard to technical terms cannot, unfortunately, alter the fact that much of the book would be rendered unintelligible to the non-expert reader for whom it appears to be intended by such glaring translator's errors as the use of "tempered" for "hardened," mechanical "elaboration" for mechanical "working," "resolving" for "dissolving," "composite" for "compound" in its chemical sense, "soldered" for "welded," "strain of extension" for "tensile strength," and many others; perhaps the most amusing example of the translator's misinterpretation of the Italian words occurs in the description of the Le Chatelier thermo couple as consisting of "platinum and radiated platinum."

Apart from these serious defects, the subject-matter of the book is not free from errors; thus the text of p. 69 definitely suggests that "pearlite" is formed from molten steel, and indeed throughout the text the difference between the eutectoid pearlite and a true eutectic is not indicated. The most satisfactory portions of the book are those dealing with malleable cast-iron, where the author is evidently on his own ground, but, taken as a whole, the book cannot be recommended to students of metallography.

W. R.

Researches upon the Atomic Weights of Cadmium, Manganese, Bromine, Lead, Arsenic, Iodine, Silver, Chromium, and Phosphorus. By G. P. Baxter, and others. Pp. vii+185. (Washington: Carnegie Institution, 1910.)

THIS memoir, which is published through the munificence of the Carnegie Institution of Washington, is one of the many series of similar researches which we owe to the Harvard School of Chemistry. It comprises eleven separate investigations on the atomic weights of the elements enumerated in the title, the results of which have been published in American and German periodicals at intervals during the past six years.

In the form in which they are now presented a few minor alterations have been made, necessitated by a more precise knowledge of certain of the fundamental values upon which the determinations are based. Certain of the original papers have had their subject-matter rearranged. The eventual results have, however, already been incorporated in the last annual report of the International Committee on Atomic Weights, and are therefore readily accessible to all workers.

Practical Measurements. By A. W. Siddons and A. Vassall. Pp. xiv+60. (Cambridge: University Press, 1910.) Price 1*s*. 6*d*.

THIS book is a development of the course of physical measurements founded by Mr. Ashford at Harrow in 1896. Recently the earlier portions have been worked under the mathematical staff. The course follows closely the syllabus of the joint committee of the Mathematical and Science Masters' Associations. It is important that teachers should read the authors' observations on p. vii., as there is a danger that the work may lead boys to suppose that "science" and "measurement" are synonymous. The course is open to the serious objection that it provides a long series of measurements which are purposeless from the boy's point of view. Thanks to the experience and shrewd observation of the authors, the book may serve as a trustworthy aid to mathematical teachers who are undertaking, for the first time, the control of classes engaged in laboratory work. Such teachers will find their routine work improved as well as lightened by its use. To sum up, the book provides a well-planned drill of a not too interesting kind, and makes it possible to insist on the work being properly done by the boy who desires to have a too easy time.

The Year-Book of the Scientific and Learned Societies of Great Britain and Ireland: A Record of the Work Done in Science, Literature, and Art During the Session 1909–1910 by Numerous Societies and Government Institutions. Compiled from Official Sources. Pp. iii+370. (London: Charles Griffin and Co., Ltd., 1910.) Price 7*s*. 6*d*.

THIS is the twenty-seventh annual issue of a widely known and very useful work of reference to which attention has often been directed in these columns. We have noticed several additions to the list of societies and associations, the work of which is described. It seems strange, however, to find in a volume issued at the end of 1910 particulars of the Winnipeg meeting of the British Association in 1909 and no references to the meetings of the association at Sheffield this year.

Cambridge. Described by N. Barwell. Pp. 64. *Norwich and the Broads.* Described by W. Jerrold. Pp. 56. *The Heart of Wessex.* Described by S. Heath. Pp. 64. All pictured by E. W. Haslehust. (London: Blackie and Son, Ltd., 1910.) Price 2*s*. net each.

THESE latest additions to the series known as "Beautiful England" are likely to be popular guide-books to the districts with which they are severally concerned. Mr. Haslehust has been successful in giving in his pictures delightful impressions of the different counties, and visitors will be glad to have the volumes to remind them of the beauties of the holiday resorts they have frequented. The descriptions are gossipy and entertaining.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Morphological Method and the Ancestry of Vertebrates.

THERE has just reached me the Proceedings of the Linnean Society for October, containing the report of an interesting discussion upon the "Origin of Vertebrates" which took place at meetings of the society in January and February of this year. Apart altogether from statements as to matters of fact which seem to be open to challenge, this discussion appears to me to raise points in regard to the methods employed by the morphologist which are of practical importance to those interested in the science of morphology.

The remarks made by Dr. Gaskell and his supporters make it apparent that there exist wide differences between what they accept as the correct principles of morphological research and those which are accepted by other working morphologists. Personally, I have been devoting myself for some time past to researches dealing with the evolution of vertebrate structure, and my impression is that there can be no wider gulf than that existing between the working principles apparently adopted by Dr. Gaskell and those adopted by myself and many other morphologists. If the principles of morphological speculation employed by Dr. Gaskell are sound, it seems to follow that those held by the majority of morphologists are absurd, and that the work based upon them represents in great part wasted labour. I will endeavour to throw into relief some of these radical differences of opinion as to general principles which appear to separate many of us from Dr. Gaskell and his friends. I feel all the more impelled to do so when I read the words of a distinguished physiologist who took part in the discussion:—"I am convinced that the principles on which he [Dr. Gaskell] has proceeded are the only ones which will lead to a solution of the problem." I fully realise that there are physiologists who would feel it rash to express themselves so decidedly as to what are, or what are not, the correct principles upon which to work in a science other than their own. Nevertheless, it seems quite clear that Dr. Gaskell's views—though they may not appeal to many who are specialists in vertebrate morphology—do produce a strong impression on many workers in other departments of biological science.

What are the principles which must be followed in speculations regarding phylogeny if these speculations are to be trustworthy? It is clear, in the first place, that whenever possible such speculations should rest upon a tripod basis of comparative anatomy, embryology, and palæontology. It is clear, further, that in fashioning each foot of the tripod certain definite rules must be adhered to if the foot is to be sound and sufficient to support the weight which is to rest upon it. For example, in making use of the data of palæontology, we have to bear in mind, firstly, that the geological record, and still more our knowledge of that record, is and must always be of the most fragmentary character, and, secondly, that in all phylogenetic speculation it is unsafe to trust to data dealing only with one single set of organs, whether these be the skeletal organs—alone, as a rule, available to the palæontologist—or any other system of organs. In the case of comparative anatomy and embryology we must bear in mind that a feature has a *prima facie* greater importance or not according as to whether or not it occurs in a more or less "primitive" group. Then, again, in both comparative anatomy and embryology it is necessary to devote great care and attention to the sifting out of features which are mere adaptations to modern environmental conditions from those which are ancestral. Finally, it has to be borne in mind that in comparative anatomy we are beset by the same kind of difficulty as that of the protozoologist when he tries to piece together isolated observations on dead material into a connected life-history, while in embryology, on the other hand, the facts, such as they are, appear to be presented to us all ready arranged in their phylogenetic sequence. These general principles apply to all phylogenetic speculations, and morphologists are probably all in agreement regarding them.

Now as regards the phylogeny of the Vertebrata. When a student under Sedgwick at Cambridge I began to realise that perhaps the most clamant need in vertebrate morphology was for a broadening of its observational basis, particularly in regard to the embryology of the more primitive forms of vertebrates. There seemed general agreement that the elasmobranchs, crossopterygians, lung-fishes, and urodele amphibians were all "primitive" groups as compared, *e.g.*, with teleostean fishes, reptiles, birds, and mammals. It seemed clearly indicated that if we were to have the general ideas of vertebrate embryology upon a trustworthy basis it was essential that the development of the crossopterygian ganoids and lung-fishes should be worked out to a similar degree of detail to what had been accomplished in the case of the other groups. My own research work during the last fourteen years has been directed according to this ideal, and has been devoted to the study of the morphology of the four relatively primitive groups mentioned above, together with, of course, the cyclostomes. As I fail to see how there can be any other scientific method of approaching the problem of vertebrate phylogeny than that which starts from a comprehensive study of such surviving forms as are admitted to be the more primitive, I may be excused for venturing to offer these remarks regarding the discussion at the Linnean Society.

One of the points raised in the discussion is the very important one, upon which I have elsewhere expressed opinions—the relations of physiology and morphology. No one has, I dare say, a greater horror than I have of that type of zoologist sometimes referred to as the "mere" morphologist—the zoologist who fails to keep before him at every moment of his work that he is dealing with living functional organisms, who fails to realise that at every stage of its evolution an organ must, in the first place, be able to function. I have at various times criticised evolutionary speculations, *e.g.* on the evolution of renal organs, or of the vertebrate limbs, or on the inadequacy of natural selection, because they seemed to ignore important physiological or functional considerations. While taking the greatest care to keep physiological considerations before us, we must, however, not forget that the *facts* upon which the evolution theory is based are morphological facts. We know nothing as yet of "recapitulation" in physiology; we have in the rocks no record of physiological change; even the science of comparative physiology is still in its infancy. The whole record of evolution is and must necessarily be mainly, if not entirely, a morphological record.

Another principle which is of much importance in morphological work is this: the greatest care must be taken to make the observational basis of speculation as broad as possible. The fewer the organs or the organisms that are made use of the less trustworthy are the conclusions drawn. *E.g.* a detailed study of the radiate eye of an insect and of a stalk-eyed crustacean brings to light the most striking resemblances, so much so that if we only knew one genus of each group and only the eye structure in that genus we should be inclined to suppose the two genera to be closely allied. I need not say that a study of the general morphology of the Antennata on the one hand and the Crustacea on the other indicates that they have been evolved separately from a simple ancestral form which existed probably long before the radiate eye had become evolved. The same kind of principle holds in regard to organisms. The detailed study of the structure of two animals may bring to light the most astounding resemblances in details of structure, and it may, nevertheless, be the height of rashness to attribute the resemblance to genetic affinity unless there exists collateral evidence which supports the view. Yet Dr. Gaskell says, "my object throughout has been by the study of Ammocœtes to find out a clue to the past history of these extraordinary early forms of fish." Is the ordinary zoologist like myself completely in error when he thinks that for "Ammocœtes" there should have been written the words "cyclostomes, crossopterygians, elasmobranchs, lung-fishes, and amphibians" in formulating

Dr. Gaskell's programme of work at this immense problem of the ancestry of vertebrates?

Personally, were I concentrating in this way on the study of Ammocœtes, I should be constantly oppressed by an uneasy feeling of absolute uncertainty as to the extent to which the cyclostomes are primitive in their structure and to which specialised for their extraordinary habits, unique amongst vertebrates. Certainly we should expect *a priori* that vertebrates that took to such a mode of life would tend to become extremely specialised. We do not even know for certain whether they are derived from jaw-possessing ancestors, though we cannot help suspecting that a vertebrate taking to the cyclostome mode of life would tend to lose its hinged jaw and become, therefore, cyclostomatous.

Another cherished principle of morphological research receives a rude jar in Dr. Gaskell's sentence, "to me and to all my friends who are accustomed to deal with the vertebrate nervous system the explanation I have given is so self-evident and natural that it is impossible to look at the matter in any other way." Are myself and other teachers of morphology talking nonsense when we urge upon those commencing research work that the frame of mind which they must endeavour to avoid at all cost, if their work is to be of value, is that in which they come to regard their working hypothesis as "so self-evident and natural that it is impossible to look at the matter in any other way"?

An important principle is that enunciated by Dr. Gaskell when he says that "each higher group of animals has arisen in succession from the highest race developed up to that time, by highest meaning the group possessing the best developed central nervous system." Apart from the trivial point that many would differ from Dr. Gaskell in their estimate of the trustworthiness of the palæontological statements by which this principle is illustrated, the principle itself seems to many a somewhat doubtful one. I take it by "high development" we mean, roughly, "complexity of organisation." Now organisation is upon the whole adaptive to functional activity. A highly organised animal is, as a rule, one the details of the structure of which are highly specialised in relation to environmental conditions. Such adaptive specialisation of the various organs renders their possessor peculiarly liable to suffer from changes in environmental conditions. It seems probable that changes of environmental conditions form one of the chief factors in compelling evolutionary change. It is at such periods that natural selection is most accentuated: the adaptable survive, the unadaptable are exterminated. It appears quite credible that when important geological or other environmental changes come about it is those forms the organisation of which shows the most complete linking up to the preceding set of conditions which are exterminated, in other words, that it is *not* the highest existing forms which proceed to evolve into a state of adaptation to the new set of conditions.

Apart from general principles, there are many important statements as to fact which seem to me to call for comment. Amongst these, for example, I read that "the evidence of the rocks points to the Silurian age as the time when the vertebrate first arose." To me it is simply incomprehensible how any biologist can really believe that the scales and teeth, comparable in complexity with those of existing fishes, occurring in Silurian formations, can be taken as having any bearing whatever upon the question of the first appearance of vertebrates. There are indeed, I think, many who feel compelled to admit that the period of evolutionary time intervening between the first appearance of the simplest chordates and the appearance of these Silurian fishes may well have been as great or greater than that which has intervened between the Silurian times and the present day.

Dr. Gaskell refers to zoologists "accepting as a commonplace the manufacture of a new organ for breathing air instead of water in the transition from the fish to the amphibian." He also says that the evidence seems to him stronger that the vertebrate alimentary canal has been formed from a pre-existing respiratory chamber "than that an alimentary canal should have taken on a respiratory function in its anterior end." I would only remark that anyone who studies the evolution of the adult vertebrate from the embryo can see for himself, as a matter of fact, that the anterior end of the alimentary canal does develop a set of gill clefts, *i.e.* a mechanism which in fishes is respiratory. Further, the only morphologist who has had the opportunity of studying the development of the lung in the lowest lung-bearing vertebrates asserts that the homology of the lung or swim-bladder of fishes with the lung of the higher vertebrates appears to him to be beyond question, and he takes the view that the lung, instead of developing "in the transition from fish to amphibian," was in all probability already present in the ancient common ancestral form from which teleostomatous fish, lung-fish, and all the higher vertebrates have been derived.

Dr. Gaskell refers to the old idea that the infundibulum of the vertebrate brain represents the œsophagus of the invertebrate, and that the suprainfundibular part of the brain represents the supraœsophageal ganglia. Such an idea would only be of value as a scientific hypothesis if based upon the facts of the earlier stages of brain development in the more primitive groups of vertebrates. I have personally studied the development of the brain in elasmobranchs, crossopterygians (Polypterus), actinopterygian ganoids (Amia, Lepidosteus), lung-fishes (Ceratodus, Lepidosiren, Protopterus), and urodele amphibians. The phenomena seen in these forms do suggest certain conclusions as to the general morphology of the vertebrate brain, as that the hemispheres are primitively paired or that the primary subdivision of the brain is into two rather than into three parts ("vesicles"). They do not suggest, however, any such view as that referred to. On the contrary, they appear to me to indicate that the part of the central nervous system which in the annelid or arthropod has become the supraœsophageal ganglia has in the vertebrates completely disappeared.

Dr. Gaskell refers to those views which "turn the animal topsy turvy, making the back of the invertebrate correspond to the ventral surface of the vertebrate." As a matter of fact, the only two stages of vertebrate ancestry which may be regarded as established with a fair degree of probability are:—(1) a protozoan stage recapitulated in the unicellular zygote, and (2) a cœlenterate stage repeated in the diploblastic stage of Amphioxus and in the corresponding stages of lampreys, elasmobranchs, crossopterygians, lung-fishes, and amphibians. We know, of course, nothing of the details of structure of the diploblastic ancestor, but it has been suggested by Sedgwick and others that these ancestral forms passed through a stage resembling in its general features the existing actinozoan. This idea, which in my opinion is still a perfectly reasonable working hypothesis, affords an adequate explanation of developmental phenomena otherwise extraordinary and ununderstandable, such as the occasional occurrence of a mid-dorsal slit dividing the central nervous rudiment and notochord into lateral halves. It would clearly be unfair to state that such a view is "doomed to failure" because it makes the back of an invertebrate correspond to the ventral surface of a vertebrate. The view does not assume the reversal of the body. It merely refers back vertebrates and cœlomate invertebrates to a common ancestor in which there was no ventral or dorsal surface—a form in which there was a certain amount of concentration of the nervous system in the region round the primitive mouth or protostoma—and suggests that in certain of the descendents of this ancestral form the normal position of the body is with the neural surface beneath or ventral (annelids, arthropods, molluscs), while in others (vertebrates) it is such that the neural surface is uppermost or dorsal.

A strong point about this view is that it suggests a possible origin of the segmented character of the mesoderm of the vertebrates. It is generally agreed that the mesoderm is of enterocœlic nature, and it was emphasised long ago by Sedgwick that just such a segmentation of enterocœlic pouches is already present within the phylum Cœlenterata in the Actinozoa.

Prof. Starling in the discussion said:—"To an onlooker like myself the striking resemblance between the earliest fishes and the Arthropoda . . . is striking evidence in favour of Gaskell's theory." Morphologists, unfortunately, have as yet no knowledge of the earliest fishes. They are acquainted only with certain dermal skeletal structures and a few impressions which give a vague

notion of the general form of certain Silurian "fish-like" forms. Assuming, however, that it is the case that to the onlooker there is a striking resemblance between the earliest fishes and the Arthropoda, it is necessary to point out that striking resemblance in superficial characters provides a type of pitfall which the morphologist has at an early stage in his education to school himself to avoid. He comes across cases of amazing resemblance, *e.g.* in pairs of "mimetic" butterflies, between a marsupial and a placental mammal, between the organ of vision of one of the higher insects and that of one of the higher Crustacea, between the skeleton of a flagellate and that of a radiolarian, and he learns to recognise that superficial resemblance may, and frequently does, provide a cloak for fundamental unlikeness. It is, in fact, one of the main parts of his business as a morphologist to find out whether in each particular case the striking resemblance so apparent to the onlooker is an expression of resemblance in fundamental points of structure or whether, on the other hand, it is merely superficial.

I think I have now said enough to make apparent how greatly some of us who devote ourselves to the problem of vertebrate phylogeny differ from Dr. Gaskell and those with him in what we regard as the necessary principles in accord with which morphological work must be done. As regards Dr. Gaskell's main thesis, that vertebrates are descended from arthropods, we take the position that what is known of the morphology of vertebrates in general, and of arthropods in general, does not justify the regarding of that view as a reasonable working hypothesis. Were Dr. Gaskell to increase by several fold his mass of detailed anatomical resemblances between an undoubted arthropod and an undoubted vertebrate, we should feel ourselves confronted, not by a demonstration of near genetic affinity, but rather by a fascinating puzzle in the way of convergent evolution. It would take up too much space, and perhaps serve little purpose, to indicate the general considerations, the cumulative effect of which is to force zoologists into the position I have indicated. I may, however, just indicate one feature, the character of the skeleton, which, as it happens, is a highly characteristic feature alike in the arthropods and in the vertebrates. In the Arthropoda we find one of the finest evolutionary inventions existing in the animal kingdom—a supporting skeleton formed out of waste products of metabolism, and so spread over the surface of their body as to form an armour effectively protecting the delicate living tissues of the body from the most varied kinds of dangers. That a group of free-living arthropods should have given up this magnificent protective device is not, of course, incredible, but before being accepted as probable it would have to be supported by an overwhelming mass of evidence.

What evidence do we, in fact, find as to the nature of the skeleton of the primitive vertebrate? We find in the vertebrate that the skeleton in the earliest stages of its development consists of a cellular rod cut off from the dorsal wall of the gut and running longitudinally along the median plane of the body. This rod, the notochord, which still persists as the main axial skeleton in the adults of some of the lowest vertebrates, occurs during embryonic development, not merely in a few vertebrate forms, but in every lower vertebrate the embryology of which has so far been investigated. There is not a single exception. Could evidence be more overwhelming that the ancestral vertebrate was a creature with a skeleton in the form, not of a hypertrophied cuticle, but of a cellular notochordal rod formed from the wall of the gut? Dr. Starling would object that "no palæontological evidence seems to be brought forward in favour of this hypothesis." The answer is a perfectly simple one. Palæontology can from the nature of the case offer us hardly any evidence whatever in regard to structures composed of soft, perishable organic material. By far the greater part of the tissues and organs with which the morphologist deals are composed of such soft, perishable materials, and all these structures, upon the *cumulative* evidence of which (taken in conjunction with the much smaller amount of evidence obtained from the skeleton) he bases his conclusions, are almost entirely absent from the geological record. I might go farther and point out that a highly developed, highly rigid skeleton is in itself a product of long-continued evolutionary change. Each animal possessing such a skeleton is the descendent of a long line of soft protoplasmic forms in which the skeleton had not yet become evolved, and these ancestral forms have, so far as palæontology is concerned, vanished for ever from our ken. It is upon the study of the comparative anatomy and embryology of existing forms alone that we have to depend when we endeavour to form a picture of what these ancestral forms were like.

The foregoing paragraphs are not meant as a criticism of Dr. Gaskell's hypothesis. They are merely meant to direct attention to an extraordinary want of agreement as to methods or principles of morphological research. It is clear that work in any department of science must be done according to some definite set of principles if it is to be of any appreciable value. In morphology, as in other sciences, there are certain generally accepted principles. It seems to me not unreasonable to ask that workers who take up morphological research should either accept these general principles and be guided by them, or, if they find themselves driven to formulate a new and better set of principles, that they should at least state these clearly and give their fellow-workers the opportunity of judging in what respects they are better and more trustworthy than those in ordinary use. Unless this is done there is apt to be caused an irritating waste of time and energy. There is, further, the danger that important work may be rejected without adequate examination, not because of its inferior quality, but simply because of the difficulty in the way of discovering common factors between it and work on the more ordinary and orthodox lines.

J. GRAHAM KERR.

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Mendelian Expectations.

MR. LEWIS BONHOTE has confirmed Mr. R. Staples Browne's statement that the web-foot in pigeons is a simple Mendelian recessive, but he finds that when webbed birds from two different strains are crossed an irregular result is obtained, viz. four normal and one webbed. Moreover, mating the first crosses yielded results in almost every case contrary to Mendelian expectations, normals throwing webs and webs throwing normals (NATURE, December 1, p. 160). Similar results have been obtained with West Highland terriers, in which white is apparently recessive to yellow. The offspring of pure-bred white terriers belonging to the same strain are white, but the offspring of pure-bred white terriers from different strains are sometimes yellow. Further, a hybrid (yellow) which produced more than 50 per cent. of white pups to a white dog of her own (Inverness) strain produced only yellow pups to a white dog of a different (Poltalloch) strain.

The explanation of these "irregular" results seems to be that the normal toes, presumably latent in webbed pigeons, and the yellow coat, presumably latent in white terriers, are restored when two strains having a somewhat different history are interbred, *i.e.* mingling the blood of two strains induces reversion. Because "points" are lost when two strains are crossed, many breeders are extremely reluctant to introduce new blood even when their stock is obviously deteriorating from in-and-in breeding. Recently a very successful breeder assured the writer that nothing in the world would induce him to use the blood of another strain to improve his white Highland terriers, and it is notorious that breeders of sheep and cattle have once and again allowed their flocks and herds to lapse owing to their reluctance to infuse fresh blood from other strains. Further, Von Oettingen has pointed out that, in the case of the English racehorse, the more remotely related the parents the less chance there is of the offspring winning races.

If crossing two strains is liable to lead to reversion, we can understand why in some hands breeding is such a lottery, why, *e.g.*, the offspring of two record racers or trotters are sometimes complete failures. The English thoroughbred breed is made up of several distinct types, each of which is now and again represented by a Derby winner. When two fleet but not too closely related members of the same type are mated, the result may prove highly satisfactory, but when the sire belongs to one type and the dam to another, and when, in addition,

the parents are so remotely related that they are separated by seven or more "free generations," the chances are (unless one of the parents is highly prepotent) that, notwithstanding the great merits of the immediate ancestors and the expectations of Mendelians, the offspring will revert to mediocrity. Hence it is not enough that breeders should "mate the best with the best, avoiding close affinities"; they must avoid crossing distinct strains even when the members of one strain closely resemble those of another. This implies that, in addition to knowing the pedigree of their stock, breeders should know as much as possible of the wild races from which modern varieties and strains were originally derived.

J. C. EWART.

Arctic Plants from the Valley Gravels of the River Lea.

I HAVE recently found a plant-bearing bed in the Low Level River-Drift of the Lea valley at Ponder's End. It is exposed in an excavation worked by the Great Eastern Railway Company, and I am indebted to Mr. Horace Wilmer, engineer to the company, for permission to carry on my investigations.

The plant-bearing bed is found at a depth of 14 to 18 feet below the surface. It is embedded in stratified gravel and sand, which presents much evidence of tumultuous accumulation. In immediate association with it are found tusks, teeth, and bones of the *Elephas primigenius*, *Rhinoceros antiquitatis* (if we are no longer permitted to call it *tichorhinus*!), and other Mammalia.

The pit is situated on the present floor of the valley of the Lea at a level of about 35 or 40 feet above the Ordnance datum.

In correlation with the archæological stages, the plant-bearing bed of Ponder's End is later than the Mousterien epoch. In fact, it is separated from this epoch by such a wide interval that it is in all probability post-Palæolithic. On the other hand, it is unquestionably pre-Neolithic, although the interval in this case appears to be comparatively short. There is thus little doubt that it comes within the period of the archæological hiatus between the Palæolithic and the Neolithic ages.

It is by far the most important plant-bearing bed that has hitherto been found upon this horizon within the area occupied by Palæolithic man in this country. It occupies a position not represented on the well-known sites of Hoxne or Hitchin. The only bed, so far as I am aware, which can be placed on the same horizon is that at the Admiralty Buildings, Westminster. This, however, only yielded two species of plants, one of them being the Arctic form *Betula nana*.

I am at present engaged upon working out the botanical material from this bed—a laborious task, occupying a large amount of time. I am submitting this to Mr. F. J. Lewis, who has very kindly undertaken its identification. A considerable amount of material has already been examined, and, so far, Mr. F. J. Lewis has succeeded in identifying ten species of plants, with four others doubtful. Three of this number, namely, *Salix herbacea*, *Betula nana*, and *Sibbaldia procumbens*, are distinctively Arctic, while most, if not all, of the remainder have a high northern range, although they are not confined to those regions. Mr. F. J. Lewis defines the assemblage as Late Glacial.

The researches of Mr. Clement Reid in beds associated with the Palæolithic deposits have shown that there have been many oscillations of climate in the south of England since the deposition of the Chalky Boulder Clay. With the evidence of this new bed before us there can be no doubt that the Palæolithic age was closed by a partial return to glacial conditions, succeeding an epoch, or epochs, when temperate conditions prevailed. This conclusion is in agreement with the results of recent work upon the mammalian fauna of the Pleistocene age.

This is not the place to enter further into this discussion. Enough has been said to indicate the importance of this bed in throwing further light upon the climatic changes of the Pleistocene age. It certainly suggests that the archæological hiatus is to be directly associated in the south of England with a final return of glacial conditions of climate.

If this view be sound, as I believe that it is, it seems to be perfectly justifiable to define Palæolithic man as interglacial, even although the last glacial phase above indicated could not, of course, compare in severity with those which preceded it.

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A New Theory of the Descent of Man.

IT is probable that some readers may fail to appreciate Prof. Klaatsch's "New Theory of the Descent of Man" at its proper worth owing to the technical terms and obscure descriptions used in the account published in NATURE of November 24 (p. 118). The theory is simply this. The Neanderthal man and the gorilla have continuous supraorbital ridges and similar markings for the insertion of muscles on their skeletons; the Aurignac man (who could pass as a fairly high type of modern humanity) has not a continuous supraorbital ridge, in which he presents a very superficial resemblance to the orang, and has certain muscular impressions on his skeleton somewhat similar to the orang's.

On this basis, which must be admitted to be "flimsy" in the extreme, Prof. Klaatsch builds his new theory and supposes that the gorilla and Neanderthal man are co-descendants of one branch, the orang and the Aurignac man of another. If one were to apply the principles used by Prof. Klaatsch to the canine in place of the human world, then we should say that the rough-haired Newfoundland is a co-descendant of a rough-haired bear, while the smooth-haired mastiff has arisen with the sleek leopard. An explanation is thus given of the points in which the Newfoundland and the bear, the mastiff and the leopard, have in common; but what of the hundred characters which the Newfoundland and the mastiff possess in common, and which separate them from the bear and leopard? Prof. Klaatsch ascribes these to "convergence phenomena." At least that is how he accounts for the fact that the Neanderthal and the Aurignac men have all the features common to humanity; one arose *via* the gorilla and the other arose *via* the orang, but both arrived at the same structural goal so alike that most of us regard them as the same species.

The theory, owing to the demand it makes on "convergence phenomena," passes somewhat beyond the limits of rational speculation. Prof. Klaatsch's theory has failed to gain the support of his able colleagues in Germany, and is not likely to receive serious consideration in this country.

A. KEITH.

Royal College of Surgeons, December 10.

The Cocos-Keeling Atoll.

IN reply to Mr. Wood-Jones's letter (NATURE, December 1), I would say that I still consider that his arguments against Sir John Murray's theory go in support of it.

Mr. Wood-Jones suggests the reason for the precipitation of calcium carbonate, *when it has once begun*, going on until the solution contains less than the normal quantity; what I wished to emphasise was that precipitation does not *begin* until more calcium carbonate than is normally present first passes into solution, *i.e.* that no crystals can be formed in the interstices of the massive corals in the lagoons until some of the dead coral is dissolved. There *is*, therefore, *proof* of solution in the lagoons of atolls.

In an early discussion on the same subject Sir John Murray pointed out that the processes of the solution of the carbonate of lime of dead shells and skeletons by sea water, and of its secretion by the living organisms, are going on side by side wherever there are life and growth, death and decay. In some regions secretion is in excess, and there is a formation of calcareous deposits; in others solution is equal to secretion, as in the red clay areas of the ocean; in others solution may be in excess of secretion, as in the larger and more perfect coral lagoons.

In small coral atolls the periphery is large relatively to the size of the lagoon, and the secretion of lime and the formation of coral sand are greatly in excess of the solution that takes place, hence the lagoon becomes filled up.

In large atolls, on the other hand, the periphery is small relatively to the size of the lagoon; there is less secretion and formation of coral sand by the living outer surface than is removed in solution from the lagoon, which is, in consequence, widened, deepened, and reduced to a more or less uniform appearance.

MADGE W. DRUMMOND.

Challenger Office, Villa Medusa, Boswell Road, Edinburgh, December 6.

Positions of Birds' Nests in Hedges.

ABOUT a year ago I wrote to NATURE (December 16, 1909) giving certain facts which I had noticed with regard to the position selected by birds when building. There seemed to be good reasons for such selection, but I wanted to know whether the conditions I had noticed were local or general. The letter sent to NATURE by Mr. A. R. Horwood showed that similar conditions were found in Leicestershire, Shropshire, and Surrey. Of the information which reached me directly, one letter deserves mention.

Mr. Francis G. Cousins enlisted some of the boys of the Johnstone Schools, Durham, as observers. Out of eight nests, the positions of which are given in the terms of my letter, two only faced north, one faced north-west, four south-east, and one south. I quote the following note sent by these observers:—"In the north-east of the district, with fairly open country, the nests faced north-east, and *at their rear was a vast extent of woods.* In the south-east of the district the nests face south-east, *with woods again at their backs* and open country in front." The italics are mine. I need not labour the conclusion that birds seek sun and warmth when building their nests. In this connection it is interesting to quote an observation made by Mr. Roosevelt ("African Game Trails," p. 290). He notes that, in Guaso Nyero, just north of the equator, the weaver birds place the mouth of the nest invariably towards the north, away from the strong, prevailing winds.

J. H. TULL WALSH.

Heath House, St. Faiths, Norwich, December 11.

Tribo Luminescence of Uranium.

I HAVE not seen in recent literature any reference to the "tribo" luminescence shown by uranium salts, and by metallic uranium in particular. Having accidentally knocked over a bottle containing 2 grams of the latter substance, I was surprised to see the bottle glow with a brilliant yellowish-white light, and on shaking the bottle the luminosity could be maintained to such an extent that the label on the bottle was read with ease, and the general illumination seen easily throughout a large lecture-room. The best way to see the glow is to bring the bottle sharply down on the palm of the hand.

On repeating the experiment with compounds of uranium, the nitrate and yellow oxide show the same effect, but to a very much smaller degree, whilst the black oxide and sodium uranate do not give it.

I expect the above must be known to workers with uranium salts, but it may be useful to some of your readers to know a method by which tribo luminescence may be so easily demonstrated.

W. A. DOUGLAS RUDGE.

Grey University College, Bloemfontein, November 18.

MARKED BIRDS IN TWO SENSES.[1]

(1) THE interesting brochure referred to below gives an account of the bird observatory belonging to the German Ornithological Society at Rossitten, which, already well known, is likely to become in the future of prime importance in securing data, by local observations and by the labelling of living birds, towards the determination of many obscure questions in bird migration.

Rossitten is situated on the narrow belt of sand-dunes, lying between Cranz and Memel, which bank out the Baltic Sea from the Kurische Haff, the more northern of the two lagoons chiefly forming the seaward face of East Prussia. The station—mainly designed by Dr. Thienemann, the distinguished ornithologist—was established in January, 1901, and fitted up at the expense and under the auspices of the Ministers of Education and Agriculture. Being, therefore, a State institution, it will possess greater stability than it could have had under the private enterprise of the society alone. Dr. Thienemann is director of the station, and holds with this post that of Custos of the zoological collections of the neighbouring university in Konigsberg. Ulmenhorst, the actual designation of the observatory, derives its name from the generous lord of the manor, Herr E. Ulmer, who presented, in 1907, the present buildings in a new and more favourable site, some seven kilometres from Rossitten, than the original installation. Here Dr. Thienemann and his assistants, cut off from the world, spend the dreary and stormy season of the year from October 1 to May 1. The station stands on the narrowest part of the sand-spit, whence the observers have a free and unrestricted view of the area between the seaward and the inner sandhills, and can study the birds which specially collect there under genuinely natural conditions. Previous observations made along this stretch of sand-dunes, on the movements of the hooded crow (*Corvus corax*), proved that a migration route of great importance passed along it, and that every year it was a rendezvous for flocks composed of the same individuals. The site, therefore, though peculiar and isolated, has been deliberately chosen because of its special advantages.

The chief objects of the observatory are to record the exact dates and composition of the migration flights, with the numbers and age of their component species; the direction in which the birds travel; the velocity and altitude of their passage (to be determined by the use of field telephones and box-kites), and the atmospheric conditions prevailing during its continuance, with the effect of any changes on the migratory stream. Many other cognate questions are to be inquired into, such as bird-life in relation to food supply, moulting, and colour changes in the plumage at different ages, the economical value of birds, and the most suitable means of protecting useful species. It is intended also to form extensive collections of the skins and internal parts of the birds of the Nehrung and neighbourhood for reference and systematic study. The scope of these observations as proposed to be carried out at Rossitten, if covering a somewhat wider field than, does not greatly differ from that undertaken by, the committee of the British Ornithologists' Union and by other observers elsewhere. Valuable as the observations all are, however, they do not, as was pointed out in NATURE of May 26, 1910, seem likely to carry us further forward than we at present are towards the solution of the phenomena of migration, until such observatories are more numerous and widely distributed; for what is now required is to trace individual birds or flocks along every part of their route from their birthplace to their winter quarters, and back again several times. These feathered armies may change their altitude, speed, and direction, or may break up into several battalions beyond the nearest horizon of an isolated observatory, and be affected in front and in rear by weather conditions unobservable from it. Even such bird observatories are as yet few in number. There is one at Riga, one in Algiers, another in Heligoland, and the one, so well known, at Buda-Pesth, which cooperates with an observer in almost

[1] (1) "Die Vogelwarte Rossitten der Deutschen Ornithologischen Gesellschaft und das Kennzeichnen der Vögel." By Dr. J. Thienemann. Pp. 36. (Berlin: Paul Parey. 1910.)

(2) "Aigrettes and Bird Skins: the Truth about their Collection and Export." By Harold Hamel Smith. With a Foreword by Sir J. D. Rees, K.C.I.E., C.V.O., M.P. Pp. iv+138. (London: John Bale, Sons, and Danielsson, Ltd., 1910.) Price 5s.

every Hungarian province. By the more crucial method of bird-marking the Rossitten observers are busily engaged in carrying out investigations which will give us eventually, we trust, the essential data referred to above: the identification of the members of a flock all along its migration route.

Besides those of Rossitten, only a few other ornithologists have attempted the "kennzeichnen" of birds. These are Prof. Martensen in Viborg, Prof. Thomson in Aberdeen, Mr. Witherby in London, and the watchers at the Heligoland station. The "marking" is done by affixing a light aluminium garter, capable of easy and quick attachment to the leg of adult birds captured for the purpose, and of fledglings before they leave the nest. The weight of these rings is so disproportionate to that of the bird that they form (as has been proved) no possible impediment to its flight or feeding. The weight of a stork's ring, for instance, is only 2·4 grammes, while that for small species is only 0·05 grammes. Each ring bears a number and the name of the station embossed on it, and when attached serves as an addressed missive for its return to the station of origin. The latter is obviously an essential factor to the success of the system. At all events, if the ring itself be not returned, its number with an accurate note of the time and place of its wearer's recapture must be communicated to the observatory, or published in some journal likely to meet the eye of the Rossitten or other European ornithologists. Each bird, as soon as ringed, is liberated to assemble with or rejoin its associates in autumn and fare forth on its adventurous voyage. The larger the number of birds ringed out of a migratory flock, the greater are the chances of prizes being drawn in this novel lottery by the man with a gun or a snare, and of data, indisputable and free from conjecture, being accumulated towards the elucidation of the routes followed by the flock, and of the terminus of its journey.

At Rossitten numbers of hooded crows, black-headed and herring gulls, storks, rough-footed buzzards, and various species of Totanidæ, Fringidæ, and Charadriidæ have been ringed since the observatory was established. The success of these experiments has been most remarkable. Large numbers of hooded crows were obtained for marking through the observatory's investigators associating themselves with the crow-catchers who frequent the dunes for the purpose of netting these birds for food. Twelve per cent. of the marked crows were recaptured, and the place of their misfortune plotted on a map, which shows that this species disperses over a wide region to the north and south. The most northern point of recapture was 30 km. from Savonlunna in Finland, and Solesmes in France, the most westerly and southerly; while Prettin on the Elbe was the most southern spot in Germany itself. From Rossitten to Savonlunna the distance is 900 km., to Solesmes 1280 km., and from Savonlunna to Solesmes 2180 km. Recaptures were also often effected in the crow-catchers' nets in the neighbourhood of the East Prussian lagoons, sometimes after the lapse of three or four years, showing that the hooded crows come backwards and forwards to this region. Strange to say not a single marked individual from Rossitten has been reported from the Netherlands.

Space does not permit our referring to any of Dr. Thienemann's other records save that of the stork, which indicates very clearly the great value of the results to be expected by and by from these investigations. The first gartering experiments on storks were made in the Zoological Gardens in Berlin on old and on half-fledged birds. They were so successful that assistance was requested, from those who had access to nests of these birds, in ringing as many individuals as possible. The observatory distributed rings free and post paid to all who requested them, on the sole condition that a list of the birds marked, with a note of the place and date of their liberation, and of the numbers on the rings, be sent to Rossitten. In the first year 1044 rings were distributed to outside helpers. The results were astonishingly successful. First of all it was proved that the storks migrate in autumn, not to the south-west, but to the south-east. On plotting the "find places" of the recaptured birds on a map, the course of their long journey from East or North Prussia, where they were ringed, could be traced out with beautiful regularity to east and south. One was returned from Poland, one each from Damascus, Acco (in Palestine), and Alexandria; one, snared by a native, from Fittrisee, in Central North Africa; one from Rosseres, on the Blue Nile; one out of a flock from Fort Jameson, in Rhodesia; one from the Kalahari desert, 8600 km. from its home, killed for food by a Bushman, who, seeing the ring, threw his prize away in terror as something uncanny! and two from Basutoland, in southernmost Africa, which were nine months old, and had travelled 9600 km. from their birthplace. The dated rings proved also that storks return from between one to three years after leaving the nest to within a distance of their natal district of from 6 to 94 km.

The recapture of certain ringed swallows in the nest in which they were born a year after leaving it raises, by the way, the interesting question: If a young bird of the previous year returns to its actual nursery, where do its parents nest? This system of marking the old and young of migrating species will unquestionably go far to provide data for solving the great mystery of bird-life; but it is essential that it be extended to the northern regions of America and Asia; and be instituted not only there, but in the middle and at the southern extremity of the journey—in Central Africa, in South America, in South China, and in Australasia—a work in which ornithologists, travellers, civil servants, and military officers in these regions could render very important assistance. Nor must the marking be confined to large birds. Passerines, because less conspicuous, and because they are captured in large numbers for food, for cage-birds and as agricultural pests, should be ringed in all holarctic regions in vast numbers while in the nest. The establishment of new observatories in these distant regions of the globe is also a matter of urgency which should be seriously dealt with by the next Ornithological Congress. Chance and happy circumstance will doubtless in time reward such efforts, and return to the expectant ornithologist answers from out of the empyrean to his numerous queries, and will yet, we trust, reveal to him the *causa causans* of the periodical restlessness that impels the novice-bird to start and guides it on its long, dangerous, often fatal, but hitherto untraversed route to winter quarters of which it has no previous knowledge.

(2) The second book on our list is, we fear, rather an apple of Sodom, fair on the outside, but, within, ashes—of gunpowder. It deals with birds marked for a very different purpose from those of Rossitten. It is chiefly made up of contributions by Mr. Harold Smith, reprinted from a paper called *Tropical Life*, of which he is editor, and from the *Times*, by various correspondents, to defend those engaged in the plume trade in the tropics from, as is suggested, attacks behind their backs and in their absence by those "bigoted members of society," "well meaning but badly informed agitators," and "egotistical humanitarians," who are urging the Government to legislate to prevent the indiscriminate slaughter of "plumage birds now

rife in certain parts of the British Empire," and, by prohibiting their import into England, to discourage the wearing of birds' skins, feathers, and plumes.

Of course, the badly informed humanitarians are the ornithologists and the lovers of birds in all parts of the civilised world. These people form, however, a large body of highly educated men and women, who among them have closely studied bird-life in every corner of the globe; and who, entirely disinterested, are possessed of—let us say—*quite* as much common sense, are as little led by "sentiment," and know "the true facts of the case through long years of experience," as well as Mr. Harold Hamel Smith and the feather traders.

The book is full of red-herring trails across the question, and of mean suggestions (*cf.* pp. 31, 41 (footnote), and 56) which are not worth our while to notice, and from which even Sir J. D. Rees, who writes a foreword to the book, dissociates himself. It would be reslaying the slain to discuss the question whether or not the slaughter of many kinds of birds for trade purposes is cruelly carried on or not. "Their [the plumers'] ravages are simply sickening," says Prof. Newton, one of the most accurate and unsentimental ornithological historians that ever lived. The evidence is overwhelming. Nor is it worth while discussing whether or not many species of birds are, through the same agencies, becoming exterminated. That question is also beyond contention. The paper on extinct and vanishing birds, by the Hon. Walter Rothschild, in the Proceedings of the fourth International Ornithological Congress (1905), should be read by those interested in this question, and also the remarks of Prof. Newton on Extermination in his "Dictionary of Birds." "The collection of skins for ornithological museums or fishing tackle," we are told, "is far more likely to exterminate a few rare birds than the millinery trade"—who, we are also told, are "the real protectors of birds"—"ever will be." The great bird collection in the British Museum, the largest in the world, contains probably about 500,000 skins, the result of more than a century's assiduous amassing. The present writer has been witness of that number of humming-birds (chiefly) and other bright-plumaged denizens of the Brazilian woods, all killed in the breeding season, being shipped in one consignment (and that not the solitary one of the season) from Rio de Janeiro to London; and has seen in the Moluccas a single canoe-load brought by native hunters consisting of scores of thousands of the most gorgeous members of the New Guinea avi-fauna spread out like wheat in a godown awaiting shipment to Europe.

Such extensive massacres, in which not only the parents but the nestlings perish, may go on for years and not become very obvious without investigation on the spot; but history shows that the results appear only when it is too late for protective measures to be taken. When a species has been reduced in numbers below a certain point, natural enemies, "red in tooth and claw," and causes difficult to determine, begin to operate, and these complete the ruthless work of man without his further interference. Another good reason for legal regulation of this trade is that, by the extinction of dominant species in a region, the equilibrium of nature is disturbed, and results disastrous to agriculture and in other directions arise. These questions formed the theme of many serious discourses by ornithologists from all parts of the world at the congress held this summer in Berlin. There the concensus of opinion was that measures must be taken internationally to prevent the present wanton slaughter of birds.

The burden of this book is that the plume-traders will suffer great loss by the exclusion of skins and feathers from this country. The same cry was raised by the slave-traders against the emancipators who struck at a "legitimate and honest trade" and "an important industry in this country." One correspondent of the *Times* writes (p. 98) it is "generous of you to offer your columns to both sides of this controversy." Mr. Smith, less generous, excludes all correspondence sent to the same journal on the protectionists' side. From one of the letters he publishes we learn that the feather trade is rapidly going to other countries, for reasons independent of threatened legislation or of interference by "badly informed agitators."

If it be true that the really large part of the trade is done in "the millions of poultry and game-birds' plumage, quills, and tails" (p. 105), why, then, this great outcry against the protection—which the traders say they desire—of the most beautiful and useful of living creatures, since tropical skins form in England so small a portion of the trade. Among the demands of the traders one is protection for the birds at their natal centre only. This the Government to some extent has done, and can do only, in its own possessions; still, its legislation instead of "not securing the preservation of a single bird" (p. 84), is providing, and will increasingly provide, very large areas of sanctuary for them. It would stultify itself if it allowed the importation of feathers from everywhere else, but prohibited it from its own dominions. Another demand is a close season (in India, for instance), after which skins and plumes would be allowed to be exported. As it is in the breeding season chiefly during which the birds don the ornamental plumage for which high prices are paid, it is obvious—human avarice being what it is—that bird slaughter would be carried on surreptitiously during that season, and the results quietly stored away until the closure was over. The expense of enforcing a close season being prohibitive, the next best means of staying the evil is prohibition of export. The "agitation" has been taken up by the Ornithological Congress, and we may shortly look forward to international regulation of the trade.

This book may contain "the truth" about the collection of "aigrettes and bird skins" as it appears to Mr. Harold Hamel Smith; but we conscientiously believe that every unprejudiced, disinterested humanitarian in this country will repudiate his assertion.

A MONOGRAPH OF THE OKAPI.[1]

THOUGH this monograph is replete with exact, and in many cases novel, information regarding the outward aspect and bones of the okapi, it will certainly strike the general reader, as well as the zoologist, as being an incomplete treatment of the subject. This may not be the fault of its principal author, Sir E. Ray Lankester, and is certainly not that of the keeper of the Natural History Museum, Dr. Sidney F. Harmer, but is apparently due to the financial control disliking the expense of publishing the volume of text, which should have accompanied the mere illustrations included in the volume under review. The reason given is that as Jules Fraipont has already published a monograph of the Okapi for the State Museum of Tervueren, Brussels—an admirable piece of work, it is generally admitted to be—the publication of the text of Sir E. Ray Lankester's studies and deductions would be superfluous. It is

1 "A Monograph of the Okapi." By Sir E. Ray Lankester, K.C.B., F.R.S., assisted by Dr. W. G. Ridewood. Pp. viii+48 plates. (London: British Museum (Natural History) printed by Order of the Trustees, Longmans and Co., B. Quaritch, Dulau and Co., Ltd., 1910.) Price 25*s*.

difficult to agree with the propriety of such a decision, and it is to be hoped that before long the text which should accompany these illustrations will also be printed and published, especially as in the interval of time which must elapse, further accurate information regarding this interesting beast may have come to hand. (The present writer has just been advised by Dr. Bumpus, of the Natural History Museum at New York, that a collector sent out by that museum has succeeded in capturing alive a male, female, and calf of the okapi, and these living forms of the animal are now being conveyed across the Congo basin for shipment to New York.) M. Fraipont's work, moreover, complete as it was for the date of its publication in 1908, is not nearly so accessible to ordinary students of zoology as the British Museum publications.

The history of the discovery of this Giraffid form at the very opening of the twentieth century has already been related so frequently that it does not need to be repeated. But the specimens received during the first few years from the present writer and others, left those zoologists who studied them in some perplexity, for they seemed to indicate, when closely compared and examined, the existence of two types, or even species, of okapi. There was considerable difference, for example, in the arrangement of the stripes on the hindquarters between the first strips of skin sent home by myself in 1900 and the complete skin obtained by me with the help of Lieuts. Meura and Eriksson in 1901, and still more in the specimens secured later by the Belgian officers in the Congo basin and a number of British explorers or natural history collectors.

As already stated by M. Fraipont, this variability of the alternations of black and white on the hindquarters and fore limbs must apparently be accepted as a characteristic feature of the okapi, and can scarcely be regarded as of specific value. But then arises the problem of the existence and non-existence of ossicones. Both the skulls sent home by me in 1901 were found to be hornless, though one presented slight swellings of the bones at the base of the nose and above the eyes, swellings to which attention was immediately directed by the whorls of hair in the skin of my large specimen, which suggested that the okapi could develop giraffe-like "horns" on those places. The complete skin and skull obtained for me by Lieuts. Meura and Eriksson, and now in the British Museum, were shown conclusively to belong to an example that was sub-adult, namely, not grown to its fullest size of development. The sex was very doubtful. The natives who brought in the skin seem to have spoken of it as the skin of a male, but it was generally adjudged to be a female.

As soon as attempts were made to transmit okapi specimens to Europe, the zoological authorities in Brussels, London, and Paris were not long in having in their hands skulls of undoubted male okapis possessing ossicones three inches long or more, some of which bore at the tip a small piece of naked bone equivalent to the beginning of an antler. Other skulls, again, supposed to be female, were quite hornless. In some cases, minute ossicones were discovered under the skin. The general conclusions to which zoologists were brought by the imperfect material at their command were: that there were either two species of okapi, one horned and one without horns; or that the comparatively speaking hornless female okapi was larger than the male: for the horned skulls of all the known male okapis are found to be smaller than those of the specimens of hornless females.

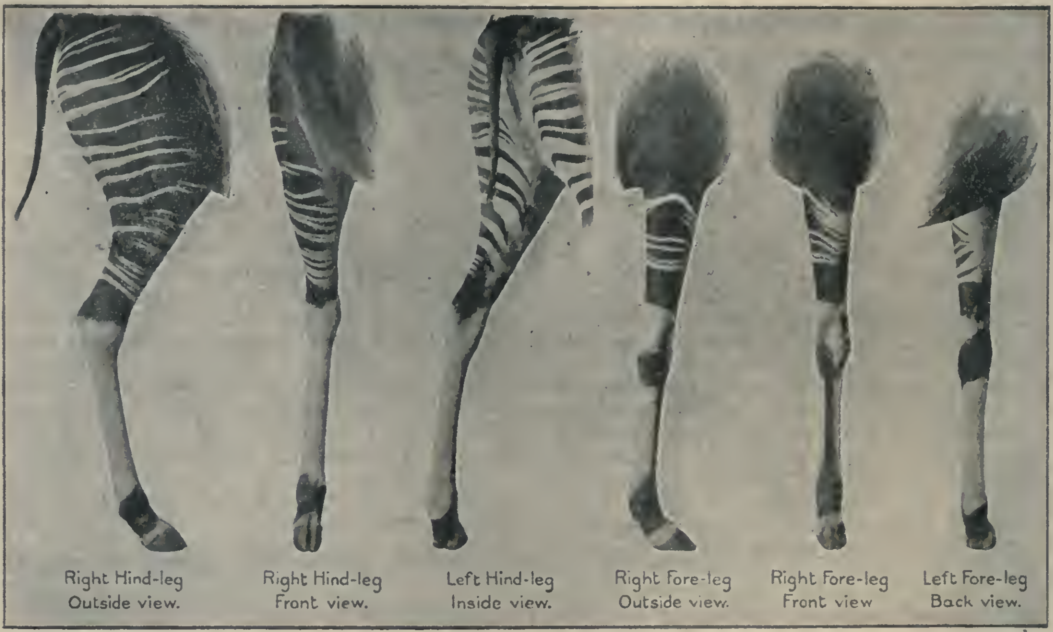


FIG. 1.—Specimen of Okapi in the British Museum (Natural History) presented by Sir Harry Johnston. From "A Monograph of the Okapi."

Then, again, the skulls seemed to be divisible into two series, broad and narrow. The question of two distinct races, subspecies, or species, of okapi (the first known of which was styled *Okapia johnstoni*) can only be decided finally by extended research. M. Jules Fraipont came to the general conclusion in 1908 that there was but one species known to us which he re-named as above, but opined that there might be distinct local races, varieties or even subspecies, within a geographical range, which, although described in the monograph under review as of limited

area, is really not so very restricted after all. The notes and observations of explorers and Belgian officials show that the okapi is met with from the vicinity of Nyangwe, in the eastern part of the Congo basin, at no great distance from the west coast of Tanganyika and from between 4° and 5° south latitude, to the River Welle at the same distance north of the equator, and almost to the banks of the Semliki River and the forests west of Lake Albert Nyanza; while its western range has already been extended (north of the main Congo) to the lower course of the Mubangi River, which lies not far away from the zoographical limits of the Cameroons district. Indeed, it would not surprise me at all if some such explorer as Mr. George Bates discovered the okapi in the Cameroons hinterland, just as he has discovered there the Black Forest pig, and other equatorial African animals first recorded in the East or Central African forests.

Whether the okapi is found anywhere to the *west* or *south* of the course *of the main Congo* is as yet unrecorded, just as we have no record of the existence of any anthropoid ape in the Trans-Congo regions. So far as our imperfect information goes, the main stream of the great Lualaba Congo acts as the limit of distribution of some other forms of mammals, and it may well be that at the time these creatures entered tropical Africa the greater part of the Congo basin was still a vast, shallow, fresh-water sea. A good many of the creatures of the equatorial belt of Africa extend from Mount Kenia and the East African and West Tanganyika forests, right across Uganda and the northern Congo basin to the Lower Niger, the Gold Coast, Liberia, and Sierra Leone, but of this series so far no trace of the *gorilla*, the *okapi*, or the *Black Forest pig* have been met with westwards of the Lower Niger, or even of the Cameroons, though there are Dutch records of the seventeenth century, as well as existing native traditions, which point to the existence of some form of Black Forest pig in the Liberian forests.

H. H. JOHNSTON.

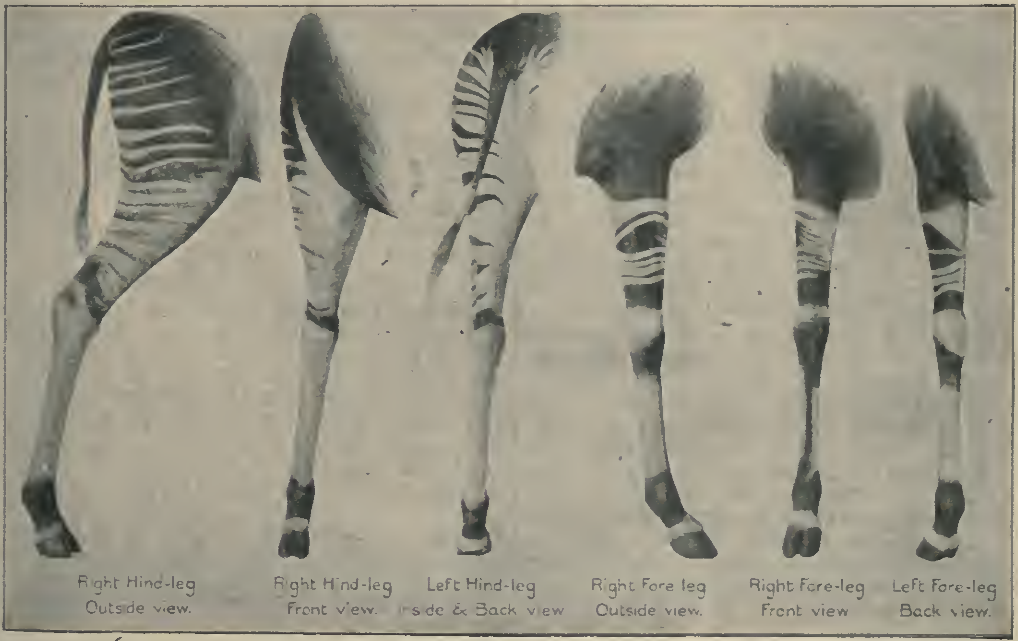


FIG. 2.—Specimen of Okapi in the British Museum (Natural History) presented by Major Powell-Cotton. From "A Monograph of the Okapi."

INTERNATIONAL MINERAL STATISTICS.[1]

TO the student of mining economics, part iv. of the Mines Report is always a volume of special interest. The publication of Colonial and foreign statistics in the present form was due to the initiative of the late Sir Herbert Le Neve Foster, to whom all interested in mineral statistics owe a deep debt of gratitude. No one, however, was more sensible than Le Neve Foster himself of the many shortcomings of this publication, as the writer of the present review can personally testify, and it is a matter of great regret that so little has yet been done to remedy some of the more glaring of the defects of this publication. It is not to be inferred that the removal of these defects is a simple or an easy matter, or even that it lies within the power of any one individual to accomplish it, for it is highly probable that nothing short of an international agreement amongst the great mineral-producing countries of the world can effect this end, even partially. Such a work as the present has for its main object the comparison of the mineral outputs of various nations, and of the conditions under which this output is obtained, mainly with reference to the labour engaged in its production and the relative danger of the miner's occupation. It is a truism that no real comparison is possible unless similar data are compared, and it is here that the main difficulty lies, the same terms being used in different countries with widely different meanings.

To take a striking example, we find in the introduction a statement to the effect that the death-rate from accidents in coal mines is as follows for the year 1908:—

Per 1000 *Persons employed.*

United Kingdom...	1·32	France	0·95
British Empire	1·45	Germany	2·46
Austria	1·10	United States	3·42
Belgium	1·07	Foreign countries generally	2·34

[1] Home Office. Mines and Quarries: General Report and Statistics for 1908. By the Chief Inspector of Mines. Part iv., Colonial and Foreign Statistics. Cd. 5284. (1910.) Price 1*s.* 8*d.*

This statement is given without comment or explanation, and leaves us to draw the obvious inference that coal-mining in the United Kingdom is attended with considerably greater risk to the miner than is the case with our French and Belgian neighbours. To those who know the true facts, it is, however, by no means certain that this greater risk in this country is a real rather than an apparent one. It is a curious fact that in no country does legislation define what is meant by a fatal mining accident. In the United Kingdom our inspectors have adopted a working definition which answers all purposes, although devoid of legislative sanction, and class as a fatal accident any accident that directly or indirectly causes the death of the victim within twelve months after the occurrence of the accident. In Belgium, however, only those accidents are considered fatal that directly cause death within thirty days of the accident, whilst in France, where no definition at all is attempted, an accident is only classed as a fatal accident if it causes directly the death of the victim, either on the spot or at any rate within a very short interval of time, whilst in Germany and Austria it would seem that for an accident to be classed as fatal it must directly cause immediate death.

It is thus obvious that if the French or Belgian accident list were calculated upon the same basis as the British, the death-rate in those countries might quite conceivably appear to be higher and not lower than our own. When the supreme importance of this matter is considered, and when it is remembered that every one of the countries concerned is engaged in discussing legislation to promote the greater safety of the miner, such legislation being not infrequently based upon the comparative degrees of safety as shown by the ratios of fatal accidents in the different countries, it is surely a pertinent question to ask whether it is impossible to agree upon an international definition of a fatal accident.

Coming next to the statistics of production, a certain degree of uniformity has been attained by expressing all the outputs in metric tons. On the other hand, however, there are unfortunately many different methods in use for estimating the outputs. Beginning with the first mineral on the list, namely, coal, there are many sources of error in the apparently simple task of recording the coal output. Even in the United Kingdom the returns as between different collieries are not comparable, the practice being here to return as output the total weight of mineral drawn up the shaft, regardless of the fact that this may contain more or less stone. So that if of two mines, which produce an equal quantity of coal properly speaking, the whole of the stone is in one case picked out below ground, whilst in the other a good deal of picking is left to be done on a picking belt at bank, the latter will be returned as producing more coal than the former. Again, the question of colliery consumption has to be considered; a certain proportion of the coals raised is used for the purposes of the colliery itself, in order to generate steam for the various engines at work, whilst in other cases, again, some of the miners are supplied free with coal for domestic purposes, this coal constituting in effect a portion of their wages. It is obvious that it will make a considerable difference in the output returns if the colliery consumption under one or both of these heads is included or excluded.

The best plan would probably be to return only the vendible coal as the output of a colliery, in which case the coal supplied to the colliers, and in effect sold to them as part of their wages, should be included, but not that used for raising steam. More important, however, is it to have a definite rule, which rule ought to be clearly and precisely set forth in the returns; some legislative enactment on the subject is obviously required. In Belgium the returns until quite recently were always those of the coal raised including stone; of late years some collieries have, however, returned only vendible coal, whilst others adhere to their ancient practice. In France the return represents the vendible coal *plus* the colliery consumption. In Germany the output returns comprise vendible coal *plus* colliery consumption *plus* a certain allowance for wastage. Further, it must be remembered that on the Continent the coal itself is very often not weighed, but its weight is estimated from the volume *e.g.* from the number of tubs of a known capacity, produced by the mine. Here, again, it is obvious that we are comparing figures which we have no means of reducing to any uniform denomination, and here, again, it is most important that there should be an international agreement as to what is meant by coal output.

Most countries assign a value to their coal production, and in the introduction to the present report the values of the coal outputs of some of the leading producers of the world are tabulated. It is interesting to calculate from this table the values assigned by the various countries to their coal, the figures obtained being as follows:—

United States	5·79*s.*	per metric ton
Great Britain	8·78	,, ,,
Germany	7·91	,, ,,
Austria and Hungary... ...	6·10	,, ,,
France	12·68	,, ,,
Belgium	12·92	,, ,,

It is obvious at first sight that these coal values must be based on more or less arbitrary data, and possess no scientific importance. Intrinsically French coal is certainly not worth more than twice as much as American coal; in fact, so far as absolute value goes, the American coal, which is here returned as the least valuable of all, is actually the most valuable, as a large proportion of high-class anthracite enters into the American production. Undoubtedly the determination of the value of a given mineral production is a difficult matter, even if a precise definition be adopted; it would probably be best to take as a basis the value of the mineral loaded up ready for transport at the mine, or, in other words, its selling price less the cost of transporting it to a market and marketing it; the only drawback to this mode of valuation lies in the fact that the values thus assigned may be liable to wide fluctuations in accordance with the laws of supply and demand. Fortunately, it may be said that of all the data contained in this report, the monetary values of the mineral production are probably the least important.

In some cases, improvements have been introduced in the methods of stating the returns; thus gold and silver are now returned in kilograms of fine metal. In many cases the output of metalliferous minerals is stated, not in terms of the weight of ore, but in terms of the weight of metal contained in the ores. The heading in the report before us says, "contained in or obtained from ore," but we assume that the latter half of this phrase is an error. The figure that is required is either the amount of metal contained in the ore or else that obtainable from it, the two being by no means equivalent statements. If the former is adopted, it means the weight of ore multiplied by the percentage of metal contained in it as determined by accurate chemical analysis, not by so-called commercial assay. If the latter method is adopted, the return would give the amount of metal that can be obtained from the ore by the smelting operations to which it is

subjected in each case; and it is therefore less than the former figure by the smelting losses of various kinds. The latter form of return would be decidedly the more useful, but is the more difficult to obtain correctly. It is, however, essential that one or other of these two methods be adopted, and not sometimes the one and sometimes the other.

The report also deals with the number of persons employed in producing the mineral output of the various countries, and there is perhaps no portion of the statistical records before us in which more divergent methods of enumeration are made use of. Some countries return indiscriminately men, boys, women, and girls, and some Europeans and natives all under the same heading, whilst others separate these categories. In Germany the usual practice is to return the full number of all names on the register, ill or well, at work or idle, working whole shifts or only parts, working throughout the year or only for a portion, as the number actually employed. The present writer does not know with certainty what the practice is in Great Britain, and doubts whether there is any generally accepted practice; certainly there is none that has legislative sanction. Most managers in this country simply return the number of men on their books on the day when the return is made out; a few seem to consider that the number of shifts worked in the year divided by the the number of shifts worked in the year divided by the number of actual working days. A better method probably would be to take as the average number of men employed daily the total number of shifts worked in the year divided by the number of possible working days. A still more exact method has been proposed by some authorities, and is carried out in some places on the Continent, in connection with schemes of insurance, namely, to take the total number of hours worked in a year by the whole of the workpeople employed, and to divide this figure by some standard figure which shall represent the average number of working hours in a year; this average number might for the United Kingdom be taken as 2400, namely, 300 days of eight hours. Obviously here, again, an international agreement is indispensable. Furthermore, it is necessary to decide whether any, and if so, which of the mine officials shall be included in the list of mine workers; the general practice appears to be to include subordinate officials but none of the staff and none of the office employés, but here again much diversity of practice exists.

Further difficulties arise with reference to the classification of mine workings, our distinction between mines and quarries being quite different from that which obtains in other countries. There is no uniformity of practice in respect of the substances which ought properly to be included in a return of mineral output, and it is an open question whether, *e.g.* brick-clay should be included as well as fire-clay, salt derived from sea water as well as rock-salt, and so forth.

Enough has been said to show that the figures in the report before us must be used cautiously, and that it is unwise to attempt to draw deductions from them unless their meaning is quite fully understood in each case. No doubt this fact detracts considerably from the utility of such a report but it need hardly be said that not the slightest blame can be imputed to those responsible for the report for the existing state of affairs. The work of the statician should, however, always be more than the mere unintelligent accumulation of figures, and here there is ample scope for someone who could persuade the principal mining countries of the world to agree upon a common basis for drawing up the essential elements of mineral records.

At the recent International Congress of Mining and Metallurgy, the question of the unification of mineral statistics occupied a prominent position, and, in fact, the only resolution that was thought worthy of being brought before the general meeting, and was unanimously adopted, was to the effect that the congress should urge upon the various Governments there represented the importance of the adoption of an international system. The report just published by the Home Office is only another proof, if such were indeed needed, of the urgency of such a step, and it is greatly to be desired that our Home Office would take upon itself to lead the way in this matter. It has for many years past made a special feature of the collection of international mineral statistics, and it would be eminently appropriate that Great Britain should inaugurate an attempt to arrive at an international understanding; there can be no doubt that the other Great Powers interested in the question would heartily welcome such a step, and that an international commission could easily enough arrive at a satisfactory arrangement. Until this has been done, all the expense, care, and trouble involved in producing part iv. of the "Mines Report—Colonial and Foreign Statistics," must necessarily be to a large extent wasted, since it cannot but fail in giving a proper comparative view of the world's mineral industry.

HENRY LOUIS.

NOTES.

THE *Times* correspondent at Stockholm reports that the Nobel prizes, amounting to more than 8000*l*. each, were distributed by the King of Sweden on December 10 with the usual ceremonial. All the prize-winners were present to receive their prizes and give the statutory lecture, except the winner of the prize for literature, Herr Paul Heyse, who was prevented by his advanced age from attending. The other recipients were Profs. Van der Waals (physics), Wallach (chemistry), and Kossel (medicine).

THE Physical Society's annual exhibition, which is to be held on Tuesday, December 20, will be open both in the afternoon (from 3 to 6 p.m.) and evening (from 7 to 10 p.m.). Prof. J. A. Fleming, F.R.S., will give a discourse at 4.15 p.m., and again at 8 p.m., on some improvements in transmitters and receivers for wireless telegraphy, and Mr. R. W. Paul will give a number of kinematograph demonstrations of some physical phenomena. Most of the leading makers of scientific instruments are sending apparatus to the exhibition.

THE opening address by Dr. Muir, C.M.G., F.R.S., to the South African Association for the Advancement of Science was delivered before a large audience in Cape Town on the evening of October 31, the day of the arrival of the Duke and Duchess of Connaught to open the Union Parliament. The main subject dealt with was "The State's Duty to Science," and the South African newspapers all agree that nothing more important or more suitable for the occasion could have been chosen. The State was viewed in succession as an educationist, a landowner, a health guardian, and as a patron of pure science, and under each head illustrations were given from the past actions and present needs of Cape Colony. The chief part of the address is reproduced elsewhere in this issue. The Minister of the Interior, General Smuts, in proposing the usual vote of thanks, threw out some hope that the day of university reform in South Africa was not

far distant. At the close of the meeting Dr. Muir presented the South Africa medal to Prof. J. C. Beattie, for his magnetic and other work.

THE jubilee of the German Agricultural Society is being commemorated in Berlin this week by a series of meetings. The Berlin correspondent of the *Times* states that at the meeting on December 12 a vast audience in the building of the Prussian Diet listened to the congratulations of the German Emperor, the Imperial Chancellor, the Prussian Minister of Agriculture, and other distinguished personages. In the course of his remarks, the Emperor is reported by the *Times* correspondent to have said:—"Many a seed has been scattered since the society was founded twenty-five years ago, and has sprung up and flourished under the blessings of peace. Admirably have you succeeded in adopting all the advances in science, in botany, in chemistry, in the breeding of animals, and in industry, and so increased the efficiency of German agriculture and raised the value of Germany's soil. Accept my most cordial good wishes for the future. May the agricultural population continue to hold its own as the core of the people, trustworthy in all circumstances, to the advantage and welfare of the Fatherland."

A GENERAL meeting of opticians and others was held in the rooms of the Chemical Society, Burlington House, on Tuesday, November 29, to consider the desirability of making arrangements for the holding of an Optical Convention in 1912. The chair was taken by Dr. R. T. Glazebrook, C.R., F.R.S., as chairman of the permanent committee. A resolution was carried *nem. con.* that, provided sufficient financial support is obtained, an optical convention be held in the spring or early summer of 1912. The main objects of such a convention were specified as being:—(1) the holding of an exhibition of optical and allied instruments; (2) the preparation of a catalogue of optical and allied instruments of British manufacture to serve as a convenient work of reference for all users of optical and scientific instruments, not necessarily to be limited to instruments actually exhibited; (3) the holding of meetings for the reading of papers and for discussions and demonstrations on optical subjects; (4) the publication of a volume of Proceedings, in which these papers would be collected together. The questions of the inclusion of a foreign section and of the scope of the convention and exhibition were discussed, and an organising committee was nominated to undertake the work of making the necessary arrangements for the convention.

THE Agenda Club, which was formally inaugurated by a banquet last week, proposes to organise effort, knowledge, and influence for the purpose of getting things done which need doing for the benefit of the community. The movement first acquired publicity through "An Open Letter to English Gentlemen" in the *Hibbert Journal.* This letter, and the club itself, appeal frankly to the idealism and the goodwill of the best men; but an equally essential characteristic of the club is to organise the altruism of its members with at least as much efficiency as that of the most successful modern business. The club expressly enunciates its need of guidance by scientific men in determining the agenda to be undertaken and in many details of its work. It is a coordinating society, and not one that overlaps the work of other bodies devoted to special purposes. Among other methods to be employed is that of the most extensive publicity. It should be able to win recognition of the importance of scientific education, to spread scientific ideas, and to extend the application of scientific method and results to the affairs of everyday life. It contemplates the encouragement of research, especially perhaps in social science, and its scheme includes groups of associates, among which are mentioned engineering, literature, medicine, and science. In thus applying tested principles and modern methods to the desire to help, which, if sometimes latent, is almost universal, the club is effecting, at a singularly opportune and critical moment, a new "grouping," which may prove a significant step forward in social evolution. There is no entrance fee and no fixed subscription. Money without other support is neither invited nor desired, but cooperation, with or without subscriptions, is both sought and welcomed. The address of the club is 4 Essex Court, Temple, E.C.

THE report of the council of the Scottish Meteorological Society was presented to the general meeting of the society held on December 6. From it we learn that the prize of 20*l.* offered for competition amongst students and graduates of the Scottish universities for the best essay on a meteorological subject has been awarded by the council to Mr. David MacOwan, of Edinburgh University, for an essay on "Observations in Atmospheric Electricity in and near Edinburgh." The council reports with satisfaction that the publication by the Royal Society of Edinburgh of the observations made on Ben Nevis and at Fort William from 1883–1904 has just been completed by the issue of vol. xliv. of the Transactions of that society. This marks the completion of a great enterprise; and it is noted that not only have the observations themselves been printed in detail, but that the four volumes in which they appear contain also numerous papers in which various theoretical and practical aspects of the observations are discussed. It is a matter of further satisfaction that almost simultaneously with the completion of the publication of the Ben Nevis observations the society has, through the generosity of its friends, been entirely relieved from the burden of debt which it had to assume when the observatories were closed in 1904. The following officers were elected at the meeting:—*President,* Prof. A. Crum Brown, F.R.S.; *vice-presidents,* J. Mackay Bernard and Ralph Richardson; *council,* J. Macdonald, Dr. C. G. Knott, Sir David Paulin, G. Thomson, H. M. Cadell, Captain H. G. Lyons, F.R.S., Sir A. Buchan-Hepburn, Bart., G. G. Chisholm, and M. M'Callum Fairgrieve; *hon. secretaries,* R. T. Omond and E. M. Wedderburn; *hon. treasurer,* W. B. Wilson.

CANCER once again formed the subject of the Bradshaw lecture, delivered by Sir Arthur Pearce Gould at the Royal College of Surgeons on December 7 before a large and appreciative audience, which included Prince Alexander of Teck. For three years in succession, 1903, 1904, and 1905, cancer—although the conditions of the endowment mention merely a "lecture on surgery"—was discussed in speculative fashion and in its surgical aspects by one Bradshaw lecturer after another. This was when the modern revival in the investigation of this disease was in its beginnings, and had contributed little that was new or could be properly appraised. Perhaps from the mere fact that all had been said, and said ably, that could be said, perhaps from a feeling that it was unseemly to harp always upon the same subject, cancer has been left alone for four years. It was well to revert to it again, for by doing so Sir Alfred Pearce Gould put himself in the position of being able to assure his hearers that great advances in knowledge have been made, and that the pessimistic views held by those brought most in contact with the disease are giving way before new hopes. The lecturer showed that the four years' respite had sufficed for the results of the comparative and experimental investigation of cancer

to make a deep impression upon the leaders of the surgical profession. He had much to say which no previous Bradshaw lecturer ever had an opportunity of knowing, and much that even his immediate predecessors had not had time to assimilate. The lecture, which appeared in full in both the *Lancet* and the *British Medical Journal* of December 10, will repay the perusal of all interested in this complex problem and the efforts that are being made to solve it.

COMMITTEES have nowadays become quite a usual form for the organisation and supervision of scientific research to take, and investigations conducted under their ægis may at times not redound in full measure to the credit of the actual workers. Therefore, in Sir Alfred Gould's Bradshaw lecture on cancer it is gratifying to note this generous tribute paid to the workers who have raised the English school of cancer research to its present pre-eminent position among kindred organisations abroad. The lecturer said:—"This college, in conjunction with our sister in Pall Mall, by the initiation, control, and housing of the Imperial Cancer Fund, has taken a very prominent part in this movement, and it is a matter of great satisfaction that the researches carried out in our laboratory are universally recognised as having been of fundamental importance. We gladly recognise that all the success which has attended, and may hereafter attend, the labours of Dr. Bashford and his distinguished associates is not due to the association with these Royal colleges, nor to the sources from which the fund has been collected, but to the ability, the wide knowledge, the patience, and the honesty that are associated with the laborious industry of the workers." However excellently committees may be constituted for advisory purposes and for control, they can never replace the initiative and enthusiasm of individual workers. It is gratifying to know that this principle is acknowledged in the investigation of a subject of such great public moment as is cancer.

THE death is announced of Captain G. E. Shelley, the youngest son of the late John Shelley, of Avington, in Hampshire, and nephew of the poet. After a short service in the Grenadier Guards, Captain Shelley retired from the Army and devoted himself entirely to ornithology, especially to that of Africa. Captain Shelley's earliest publication was a "Handbook on the Birds of Egypt," a most useful companion to the voyager on the Nile, illustrated by many excellent coloured plates drawn by Keulemans. He next turned his attention to the sun-birds (Nectariniidæ), and in 1880 completed a beautiful quarto work containing coloured figures of every species of this brilliant family, which may be said to represent the humming-birds of the New World in Africa and Asia, although the two groups are by no means nearly related to each other. In 1890 Captain Shelley was requested by Dr. Günther to join Mr. Sclater in preparing the nineteenth volume of the great "Catalogue of Birds in the British Museum." To this he gladly consented, as among the families included in this volume were the cuckoos and other groups of which he had made a special study. Captain Shelley now planned a general work on the birds of Africa, in which he proposed to comprise an account of all the birds known to occur in the Ethiopian region. The first volume of this important work was published in 1890, and succeeding volumes were issued up to 1906, when the failing health of the author brought the continuance of the work to a stop. Besides these three works, Captain Shelley was for many years a constant contributor to the *Ibis*, the journal of ornithology published by the British Ornithologists' Union, of which he was a well-known member. He was also an excellent field naturalist, and made many excursions to different parts of Africa in order to observe the bird life with his own eyes and to add to his valuable collections, which, we believe, have attained a final resting place in the British Museum.

THE Berlin correspondent of the *Times* reports the death, at seventy-eight years of age, of Prof. Franz König, who held in succession the chair of surgery at the Universities of Rostock (1869), Göttingen (1875), and Berlin (1895). He retired from the latter chair in 1904. His reputation was based largely on his skill in the treatment of articular tuberculosis, on which he published a monograph in 1883 (later edition, 1895). He was also author of teaching manuals of surgery, which were frequently republished.

THE *Aëronautical Journal* for October contained the announcement that the council of the Aëronautical Society had conferred the gold medal of the society on Mr. Octave Chanute, consulting engineer, of Chicago. It was regretted that there was no immediate prospect of his being able to receive the medal in person, owing to the serious illness which overtook him at Carlsbad, from which, however, it was confidently expected that he had recovered after removal to Paris. It is with greater regret that we now learn of the death of Mr. Chanute at seventy-eight years of age. Born in Paris in 1832, Chanute trained as an engineer in America, where his professional duties involved the construction of numerous railways and bridges, including consultative duties connected with the New York elevated railway; wood preservation was also his speciality. From 1874 onwards Chanute became interested in the problem of aviation, and not only did he make numerous experiments with models, but shortly after, or perhaps simultaneously with, Lilienthal and Pilcher's experiments in Europe Chanute took up the practical realisation of gliding flight in America in collaboration with Mr. Herring and Mr. Avery. A large number of glides were made with different types of glider, commencing with a model based on the descriptions of Le Bris's historic "albatross," and including gliders with a large number of superposed planes, but the type finally adopted was a biplane glider furnished with a smallish balancing tail. Although balance was, as a rule, maintained by moving the body, Chanute embodied in his apparatus the principle of a flexible framework, which thus paved the way for the Wright Brothers' "warping" devices and similar arrangements for the recovery of balance and counteraction of instability, which form such a noteworthy feature of modern aëroplanes. The glides made with his machines were remarkably successful, and, the practising grounds being among sand dunes, no fatalities ensued. Chanute was the author of a number of papers and reviews dealing with the flight problem, and the Wright Brothers, the late Captain Ferber, and numerous other aviators were indebted to him for much valuable assistance.

THE annual general meeting of the Royal Agricultural Society of England was held on December 7. It was announced that the total membership is now 10,129, having reached five figures for the first time since 1901. The report, which was adopted at the meeting, contains abundant evidence that the society is assisting scientific research in agriculture in a substantial manner. At the Woburn Experimental Station, in addition to general experiments, trials have been made of the new varieties of cross-bred wheats introduced by Prof. Biffen, of Cambridge, and also of French wheats. The residual values of calcium cyanamide and nitrate of lime have been ascer-

tained in comparison with sodium nitrate and sulphate of ammonia. The pot-culture work has included further experiments on the influence of magnesia on plants. The Hills' experiments concerned chiefly the use of zinc in different forms and of lithium. The question of green-manuring with leguminous and non-leguminous crops respectively has been advanced a further stage. In the botanical department some forty specimens of infected plants were sent for examination. For the most part these were attacked by common diseases, but the following are not so generally met with:—silver-leaf on black currant, Pseudomonas on swede, and Hypomyeces on mushrooms. Two diseases, one on mangolds the other on asparagus, are apparently new to science, and are now under investigation. The society has decided to carry out experiments with calves at the Woburn Farm, for the purpose of demonstrating that by means of isolation it is possible to rear healthy stock from tuberculous parents. Lord Rothschild has undertaken to provide, free of all expense to the society, thirty calves for the purposes of the proposed demonstration. The arrangements are in the hands of a special committee, and Sir John McFadyean has undertaken to supervise the demonstration. With the view of enabling the Royal Veterinary College to make further investigations as to Johne's disease, an obscure disease of sheep met with in certain parts of England, and vaccination as a preventive against tuberculosis in cattle, the council has agreed to make a special grant to the college of 200*l.* per annum for three years, commencing on January 1, 1911.

THE trustees of the Beit memorial fellowships for medical research have elected the following persons to fellowships. We give in each case the general character of the proposed research and the place where it is intended to carry out the research:—*T. R. Elliott*, pathological changes in the suprarenal glands, at the Medical School of University College Hospital. *E. E. Aitkin*, investigation of a group of toxins with respect to the manner of destruction, mode of neutralisation by antibody, and effect of the various modifications upon the animal organism, at the Bacteriological Laboratory of the London Hospital. *Frances Mary Tozer*, the presence of sensory fibres in the third, fourth, and sixth cranial nerves; their influence upon ocular paralysis in locomotor ataxia and other diseases, and the site of the ganglion cells, at the Physiological Laboratory, Liverpool University. *R. W. H. Row*, the structure, development, and functions of the pituitary body in Vertebrata, at (1) King's College, London (Zoological Laboratory); (2) Marine Biological Association's Laboratory; and (3) Naples Zoological Station (collection of specimens and embryological and experimental work). *H. Priestley*, study of the diphtheroid organisms with regard to their distribution, morphology, cultural characteristics, pathology, and relationship to diseased conditions of man and animals, at the Lister Institute of Preventive Medicine. *F. P. Wilson*, the changes in the lipoids of the tissues produced by syphilis and their relation to hæmolysis and immunity, at the Biochemical Department, University of Liverpool. *A. G. Yates*, the bacteriology of acute rheumatism, at the Pathological Department of the University of Sheffield. *Annie Homer*, the chemistry and physiology of tryptophane; the metabolism and chemistry of hæmoglobin in so far as they bear on its production in the animal body; the comparison of normal and pathological tissues as regards their contents of intracellular ferments, at the Physiological and Chemical Laboratories, Cambridge. *F. J. F. Barrington*, investigation of the functions of the male accessory genital glands, at University College Medical School. *J. F. Gaskell*, the origin of the suprarenal body in the invertebrates and lower vertebrates, and on the function of the chlorogogen cells in invertebrates, at St. Bartholomew's Hospital Medical School. The next election of fellows will be held in December, 1911. Correspondence should be addressed to the honorary secretary, Beit Memorial Fellowships for Medical Research, 35 Clarges Street, W.

IN the *Philippine Journal of Science* (vol. v., No. 3) Mr. R. B. Bean gives a further account of his investigations into the different types of ears occurring among the Philipinos, giving on this occasion illustrations of the Iberian and the primitive types. In the former the characteristic features are the inversion of the conch and the rolling out of the helix, this producing a shallow bowl in the conch and a flat helix below. The whole ear is thin, flattened, and usually placed parallel to the head. The primitive ear, on the contrary, is distinguished by the inversion of the conch and the rolling in of the helix, the upper and lower portions of the latter projecting in the form of a shelf, while the conch is deep and bowl-like. The whole ear is thick. In the opinion of the author, ears afford much better race-characters than skulls.

IN the report for the year ending September 20, the committee of the Bristol Museum and Art-gallery expresses its obligation to Lady Smyth for her gift of 1500*l.* to fit up a companion room to the one for which she had previously provided funds. This will enable the adjacent rooms to be arranged in uniformity. Among the additions to the collection is the skin of a giraffe from East Africa, which is now in the hands of the taxidermist, and will in due course be installed in the building.

THE new museum and art-gallery opened at Plymouth on October 25 form the subject of an illustrated article in the November number of the *Museums Journal*. The foundation-stone of a building was laid so long ago as the Diamond Jubilee year of Queen Victoria, but soon after this was done the financial affairs of the city became involved in difficulty, and further progress was stopped. Later on Mr. Andrew Carnegie offered a large sum for the building of a public library, and it was eventually decided to combine with the library a museum and art-gallery, for which funds were provided from other sources. The result is the present fine building, constructed partly of Portland stone and partly of Devonian limestone, with a total frontage of about 320 feet. Of this, the northern 180 feet are allotted to the museum and art-gallery. The whole building is one of which Plymouth may justly be proud.

AMONGST publications recently issued by the International Council for the Study of the Sea are vol. xii. of the *Rapports et Procés-Verbaux*, vol. iv. of the *Bulletin statistique*, and No. 48 of the *Publications de Circonstance*. The first of these contains useful summaries of the fishery work carried out under the direction of the council. Dr. Hoek gives an account of the recent work on eggs and larvæ of the Gadidæ, Prof. D'Arcy Thompson of that on the distribution of the cod and haddock, Dr. Ehrenbaum on the eggs and larvæ of flat-fishes and Dr. Masterman on their later stages, and Dr. Hjort reports on the herring investigations. The statistical bulletin contains a summary of all fish landed in the different European countries in 1907. The last of the three publications deals with the plankton researches, and gives a list of all organisms which have been recorded between 1905 and 1908 on the periodic cruises, with an account of the stations at which they were found. This forms a useful summary of the detailed tables published in the bulletins.

IN an abstract from the *American Breeders' Magazine* (vol. i., No. 2) Dr. G. H. Shull adduces further evidence in favour of a so-called pure-line method in corn breeding that consists in raising self-fertilised generations with the object of developing pure homozygous strains or biotypes, and then cross-breeding from such pure strains year by year.

A NOTE on works of improvement in the forests of the Federated Malay States, contributed by Mr. A. M. Burn-Murdoch, appears in the *Indian Forester* (October). The author distinguishes gutta-percha forests, where *Palaquium gutta* and *P. oblongifolium* are the important species, and mixed timber forests. Under natural conditions the Palaquium forests contain a great number of tall, slender trees in the pole stage arising from an undergrowth of palms, chiefly *Eugeissona tristis*, and shrubs; there are also a few giant trees. When the young trees are cleared of the undergrowth some are unable to support their own superstructure and require lopping, from which, however, they quickly recover.

A PALM disease receiving the name of "koleroga" is described at length by Dr. L. C. Coleman in Bulletin No. 2, issued by the Department of Agriculture in the Mysore State. The disease, confined to the Areca palm, has been prevalent in two separate areas on the west coast of India. For the most part the fruits are attacked, but occasionally the fungus finds its way to the growing apex. Spraying with Bordeaux mixture has proved efficacious. From a study of the sporangiophores, zoospores, and both kinds of sexual organs, and from infections made with the spores, the author concludes that the fungus is very closely allied to the well-known *Phytophthora omnivora*, from which he separates it as a special variety.

THE prominent item in the September number (vol. v., No. 4) of the botanical section of the *Philippine Journal of Science* is the first part of a description, by Mr. E. D. Merrill and Mr. M. L. Merritt, of the flora of Mt. Pulog, the highest, but until recently little known, peak in the island of Luzon. Four zones of vegetation are distinguishable, of which the most important is an open forest belt in which *Pinus insignis* is the characteristic tree; this gives place at an altitude of 7000 feet to a denser forest of irregular trees covered with mosses and lichens, where epiphytic ferns and orchids are abundant, while the summit is open meadow. In the flora the families Polypodiaceæ, Compositæ, and Gramineæ are best represented. There is a predominance of continental Asiatic as opposed to Malayan types, together with a definite, although small, admixture of Australian elements.

MR. BERNARD SMITH has written on the Upper Keuper sandstones of east Nottinghamshire in the *Geological Magazine* for 1910 (p. 302). His study of the characters of these rocks bears out the view, shared by Mr. Cresswell in the paper above referred to, that they were accumulated in distinctly shallow water. "Large tracts with isolated pools were laid bare from time to time." The sandstones among the marls are the deposits of wet seasons, and show characteristic signs of flood and current action. Mr. Smith suggests that the grey or green beds in the Keuper are due to the check on oxidation caused by organic remains and humic and organic acids swept down from the land-surface.

FROM the report of the chief of the U.S. Weather Bureau for the fiscal year 1908–9 we note that observations of the lower strata of air by kites and captive balloons are made daily except on Sundays; efforts are being made to secure materials for kites that will not absorb moisture. Measurements of the intensity of solar radiation and the polarisation of sky light were made whenever conditions were favourable; both appear to have had a higher value than during the previous year. Isobaric charts based on telegraphic reports from selected stations throughout the northern hemisphere have been prepared daily, and successful forecasts for about a week in advance have been issued at intervals; Prof. Moore remarks that the application of world-wide observations and upper-air researches to the art of weather forecasting, both for short and long periods, is yearly becoming more apparent. Reports of marine observations by wireless telegraphy have been discontinued on the Atlantic, but the work has been taken up, to some extent, on the Pacific coast. In the climatological summaries we note that the total precipitation is determined from amounts recorded daily, from midnight to midnight.

DR. L. BIRKENMAJER, of the Cracow University, the author of an elaborate biography of Copernicus, has been fortunate to find (in the "Riks-Arkivet," Stockholm, and in the library of Upsala University) several entirely unknown autographs of Nicolaus Copernicus. The most interesting is a letter written by the great astronomer, on behalf of the Bishop and the Cathedral Chapter of Ermland, on July 22, 1516, to Sigismond I., King of Poland. This message conveys to the King embittered complaints against the Teutonic Order "the Knights of the Cross," described as "praedones, latrones et homines scelerati" in the text of the document, which is entirely in Copernicus's own handwriting. For other interesting details we must refer to the memoir published by Dr. Birkenmajer, in collaboration with the distinguished Upsala scholar Dr. Isak Collijn, in the *Bulletin International* of the Academy of Sciences of Cracow, June, 1909.

THE paper read by Sir Robert Hadfield and Prof. B. Hopkinson before the Institution of Electrical Engineers on Thursday last marks an important advance in our knowledge of the magnetic properties of iron and its alloys. By working in the intense fields obtained between the poles of a large electromagnet they have succeeded in showing that iron and its alloys with carbon, silicon, aluminium, nickel, or manganese have definite saturation intensities of magnetisation which are reached, in general, in fields of less than 5000 units. For pure iron the saturation intensity is 1675 units, and for iron carbide about two-thirds of this. Each alloy behaves as a mixture of one or more magnetic substances with materials having permeabilities not differing much from unity. In annealed carbon steels the saturation intensities are 6 per cent. less than for pure iron for each per cent. of carbon present. The tests of alloys of iron with nickel and manganese have not led to any simple relation between their magnetic properties and their composition.

SINCE Coulomb stated the laws of friction of solids on each other more than a century ago, little work has been done on the subject except from the technical point of view, which does not attach much importance to the absolute cleanliness of the surfaces in contact. The *Verhandlungen der Deutschen Physikalischen Gesellschaft* for October 30 contains a short account, communicated by Prof. W. Kaufmann to the Versammlung Deutscher Naturforscher, of some careful experiments on the subject made by his pupil Miss C. Jakob. The glass or brass surfaces used were chemically clean, and were used in a glass

chamber, which could be evacuated and dried. The observations were made by tilting a large plate of the material with a perfectly smooth surface until a small piece of the same substance, provided with three spherical feet, would slide down the surface. Sliding begins at a very small angle, 1·5° for glass, and the speed has a fixed terminal value for each angle of tilt up to a little more than 5°, when the motion becomes an accelerated one. Up to this point there is a definite relation between the speed and the friction, and this relation must be substituted for the discontinuous law of Coulomb, according to which friction prevents motion until an angle of tilt of the order of 10° or 20° is attained.

AN interesting article on critical speeds for torsional and longitudinal vibrations, by Prof. Arthur Morley, of University College, Nottingham, appears in *Engineering* for December 9. The driving effort of a reciprocating engine, or the resistances to be overcome, may be periodically fluctuating in magnitude, and if the period of such a variation should approach to the period of a free torsional vibration, or to an integral multiple of it, torsional oscillations of some considerable magnitude may be set up, with accompanying high stresses in the material of the shaft. Cases of approach to dangerous resonance with longitudinal vibrations are perhaps much less common in machinery. The author gives a complete mathematical analysis in the article, and concludes with an interesting application to the case of a pit cage and contents weighing ten tons, and being raised by an engine running at 100 revolutions per minute. Taking the net section of the rope at 2·5 square inches and E as 13,000 tons per square inch, the depth at which the natural frequency of vibration of the loaded rope is equal to the speed of the engine is 955 feet, neglecting the weight of the rope. Taking a rope weighing 8·4 lb. per foot, and making allowance for its weight, the depth at which resonance will occur works out to about 862 feet.

OUR ASTRONOMICAL COLUMN.

NOVA ARÆ, 98.1910.—A telegram from Dr. Ristenpart to the *Astronomische Nachrichten* (No. 4457) states that the magnitude of Nova Aræ, recently discovered by Mrs. Fleming, was 9·6 on November 19.

The nova is invisible on forty-four plates of the region taken at Arequipa during the period August, 1889, to March 19, 1910, but appears on twenty-one photographs secured between April 4 and August 3 of this year; on these plates its magnitude apparently ranges from 6·0 to 10·0, and thus it would appear that between March 19 and April 4 the magnitude increased from 12·0, the limiting magnitude of the Arequipa plates, to 6·0. Like most of its class, this nova lies well in the Milky Way, its position (1875·0) being $\alpha=16$h. 31m. 4s., $\delta=-52° 10·4'$.

SATURN'S RINGS.—Herr K. Schiller, writing to the *Astronomische Nachrichten* (No. 4458), states that he observed Saturn's ring system on November 26 at Bothkamp, and could detect no extraordinary feature such as was described by M. Jonckheere in an earlier communication; the atmospheric conditions were excellent, and Herr Schiller employed powers of 200, 600, and 800.

PUBLICATIONS OF THE ALLEGHENY OBSERVATORY.—We have received the first four numbers of vol. ii. of the Publications of the Allegheny Observatory of the University of Pittsburgh, and give brief abstracts of them below. In No. 1 Prof. Schlesinger describes the Mellon spectrograph with which he and the other observers prosecute their radial-velocity researches. This instrument was provided, by the generosity of Mr. Andrew Mellon, for line-of-sight work when the Keeler memorial telescope was completed in 1906. The grave disadvantages arising from the location of an astronomical observatory near a large town, where the sky is never clear and ever illuminated by artificial illuminants, had to be considered when the form of instrument was under contemplation. Consequently, the work which is possible had to be materially restricted, because of the necessity of keeping the possible exposures within reasonable limits, and a one-prism spectrograph was designed. The sacrifice was considerable, but peculiar circumstances rendered it necessary. However, it appeared that useful work might be done if the investigations were confined to such stars as have broad, hazy lines, and this decision has been justified by the results already published. Dr. Schlesinger describes and illustrates the details of the instrument, showing how rigidity has been attained with moderate weight. A region of the spectrum from λ 3930 to λ 4750 can be brought into sharp focus, and under exceptionally good conditions a strong spectrum of a fifth-magnitude star can be obtained in about twenty minutes. Owing to the impurity of the town atmosphere, the large mirror of the Cassegrain reflector has to be resilvered once a month, and the small one every other week; even then, at times, they only reflect about half as much light as when newly silvered, and some 40 per cent. of the deterioration takes place within three or four days of resilvering. The arrangements for maintaining the temperature range of the prism box within 0·1° C., for eliminating flexure, and for adjusting the focus are minutely described and very ingenious.

In No. 2 Dr. Schlesinger and Mr. D. Alter discuss the relative motions of 61 Cygni and similar stars. This discussion indicates that the motion of the companion star is orbital rather than in a straight line—that the two stars are physically connected; thus the designation "of the 61 Cygni type," as indicating pairs not physically connected, should be abandoned.

No. 3 contains a discussion of the orbits of the spectroscopic components of ϵ Herculis, by Dr. R. H. Baker, determined from seventy-two plates taken with the Mellon spectrograph during 1907–8. The period is found to be 4·0235 days, and the orbit nearly circular; there is no substantial evidence for the presence of a third body. In No. 4 Dr. Baker discusses the orbit of 1 H. Cassiopeiæ, from fifty-seven plates secured during 1908–9, and finds the period to be 6·067 days.

THE ORBIT OF THE PERSEIDS.—Meteoric astronomy is being, and is likely to be, considerably advanced by the energetic and organised observations of the Antwerp Société d'Astronomie. Since 1896 the Perseid and other showers have been independently observed at many stations, and the results collated and discussed. During 1909 and 1910, 485 and 303 Perseid trails were recorded, and indicate the existence of seven radiants. For five of the best marked of these M. Henri Dierckx has calculated elliptic elements, which he compares with Hayn's elements for Tuttle's comet, 1862 III., in an article appearing in Nos. 11–12 of the *Gazette astronomique*. The agreement is well marked, although, as the author remarks, the probably large area covered by the swarm of meteoritic particles precludes the expectation that the Perseid elements would rigidly agree *inter se*.

DEFINITIVE ELEMENTS FOR THE ORBIT OF COMET 1904 II. (1904*d*).—This comet was discovered by M. Giacobini at Nice on November 17, 1904, and was observed until May 2, 1905. Herr J. Sedláček has now discussed 118 observations, referred to eighty-four comparison stars, and publishes the resulting orbital elements in No. 4453 of the *Astronomische Nachrichten*. The orbit appears to be hyperbolic, but the departure from a parabola is so slight as to be practically negligible.

DESIGNATIONS OF NEWLY DISCOVERED VARIABLE STARS.—In No. 4457 of the *Astronomische Nachrichten* the commission of the AG Catalogue of Variable Stars gives the permanent designations to 126 recently discovered variable stars. Many of the objects have been discovered to be variable during the present year, whilst the variability of others was detected during preceding years. In addition to the designations, the commission gives the provisional numbers, the positions for 1900, the range of magnitude, and remarks concerning the discovery, the period, the type, and the spectrum of each object.

THE TRANSANDINE RAILWAY.

It was on March 29, 1835, that Charles Darwin, who had reached Mendoza from Valparaiso by Peuquenes and Portillo, set out on his return journey across the Andes by the more northern line of the Uspallata and Cumbre passes, which has always been the principal means of communication between the pampas and the Pacific Coast. It was not until twelve days later that he reached Santiago, though no doubt a less ardent geologist might have completed the journey in somewhat shorter time. It could now be easily accomplished by rail in less than the same number of hours.

FIG. 1.—Valley of the Rio Mendoza below Puente del Inca, looking up stream; the rack rail is seen in the foreground.[1]

The Transandine railway is constructed on the metre gauge, like many of the Indian lines, although it links up two broad-gauge systems. Leaving Mendoza, where it connects with the Argentine Great Western at a height of 2700 feet above the sea, it turns southward across the plain, making for the point where the Rio Mendoza leaves the eastern or Uspallata range of the Andes, and then follows the windings of the deep river valley through the mountains. It thus takes a route somewhat to the south of that by which Darwin and other travellers crossed this range. According to their descriptions, the eastern slopes are composed of Rhætic sandstones and bituminous shales resting on Devonian and Ordovician slates, such as are found in many parts of the Andes. These are covered unconformably still further to the westward by thousands of feet of acid and basic lavas and tuffs interstratified with sandstones and carbonaceous shales, and believed to be of Tertiary age. Intrusions of granite and porphyry also occur.

After emerging from these mountains and traversing the Uspallata Pampa, a plateau of coarse detritus at an altitude of 6000 feet, the railway enters the central cordillera of the Andes by the deep gorge of what may still be called the Rio Mendoza, though, like most South American rivers, it is known by different names in different parts of its course. Here the slates are covered apparently conformably by a thick succession of Mesozoic rocks described in detail by Darwin, Stelzner, and Schiller. They include acid lavas and tuffs, breccias and conglomerates of the same material passing into arenaceous rocks, amygdaloidal basalt, limestones, gypsum interstratified with red and purple sandstones and conglomerates, and finally lava flows, tuffs, and conglomerates, consisting mainly of andesite, which are probably of late Cretaceous or even early Tertiary age. Although marine fossils of Jurassic and Cretaceous types are met with, some of the beds were probably laid down under continental conditions. On the east the rocks are much disturbed, and are penetrated and metamorphosed by granite and diorite, as well as by minor inclusions, which traverse, not only the stratified, but the plutonic rocks.

The sides of the gorge present magnificent sections of the geological structure, one of the finest of which is at the mouth of the Horcones valley, by which Aconcagua was successfully ascended. At Las Cuevas, a little further on, the train enters the tunnel beneath the Cumbre ("summit") pass and emerges in the valley of a tributary of the Rio Aconcagua, which makes its way westward to the Pacific. The tunnel is less than two miles long, and little more than 10,000 feet above the sea, while the pass is some 2000 feet higher. It is stated to have been excavated in limestone and gypsum, and conglomerates of rocks of igneous origin. The western slopes of the ridge are exposed to the wet north-west winds, and the rocks are in places saturated with water and decomposed, so that it was necessary to face the interior of the tunnel with concrete.

The railway then follows the valley of the Aconcagua,

FIG. 2.—Scenery on the Chilian side of the tunnel.

where the later volcanic rocks dip at moderate angles to the westward, and are penetrated here and there by intrusions of "porphyry," down to the fertile plain of the same name, where at Santa Rosa de los Andes it connects with the State railways of Chile. On account of the steepness of the valley slopes and the decomposition of

[1] The illustrations are reproduced, with permission, from a paper by Mr. W. S. Barclay in the November number of the *Geographical Journal*.

the rocks the construction of the line on the western slope presented serious problems to be solved, and the central rack rail is almost continuously employed for a distance of fifteen miles, while on the Argentine side it is only occasionally resorted to.

Nearer the equator, where south-easterly winds prevail, there are railways which, starting from the Pacific Coast, reach an altitude of more than 14,000 feet without the use of any special appliance of this character, for the rainless western slopes present comparatively few engineering difficulties; but when the time comes for railways to be built down to the Amazonian plain it will be no easy task to construct a firm track through the deeply dissected country, where the almost continuous rain has decomposed the rock to a considerable depth, and from time to time great landslips leave a strip of the valley-side denuded from crest to base of its thick covering of trees.

The opening of this through route from the Atlantic to the Pacific is an important step in the development of communications in South America. Soon the Argentine railways will be united to those of Bolivia and Peru, and the lowlands of Bolivia rendered accessible by the railway round the cataracts of the Madeira. Everywhere the plateau, the pampa, and the forest are losing their remoteness and their solitude, and bid fair to be occupied, ere long, with a population drawn from European sources, a consummation that, however natural and inevitable it may be, cannot but inspire some vain regrets in those who have known them when they were still in the state in which the early Spanish adventurers found them.

JOHN W. EVANS.

EVOLUTION: DARWINIAN AND SPENCERIAN.

ON Thursday, December 8, the Herbert Spencer lecture at Oxford was delivered by Prof. Meldola, F.R.S., the title of the lecture being "Evolution: Darwinian and Spencerian." Prof. Meldola began by pointing out that while Oxford had influenced Darwin through Lyell (whose reputation, however, was made by throwing over the doctrine of his old master at Oxford, Buckland), it had also influenced Spencer through both Lyell and Mansel. Evolution, the lecturer proceeded, did not stand or fall with natural selection, but the prominence given by Darwin to the latter principle availed to convert Spencer from exclusive Lamarckism. Darwin and Spencer approached the problem of evolution with different types of mind, and addressed themselves to different audiences; the special task of Spencer was to show that organic evolution was a particular case of general evolution. In this he entirely succeeded, points of objection that might be taken to his views being of minor importance. Selection, so far, had only been shown to prevail in relation to the phenomena of life. Darwin's influence in departments where selection is not found was only indirect.

There was a fundamental difference in the method of attack of scientific problems adopted by Darwin and Spencer respectively. The procedure of the former was analytic, that of the latter synthetic. For Spencer, philosophy was unified science. His treatment of scientific questions was characterised by extreme breadth, inasmuch as his principles transcended the data of particular sciences, this being one reason why he failed to impress scientific men so much as might have been expected. No such attempt to wield the weapon of unified science had ever before been made. In estimating the comparative validity of the methods employed by the two men, it should be remembered that Darwin was working at a lower level; thus his foundations were more securely laid; and however sound the method, information can, after all, only be acquired by beings of finite intelligence and imperfect sense organs. Hence mistakes could be, and actually were, made; these, however, the same method would be competent to correct in the presence of better information. Spencer's plan, on the other hand, was to prove the existence of underlying principle controlling all the processes of nature. Hence his method was philosophical in the more enlightened sense of that term—the sense seen in the old expression "natural philosophy."

From this point of view the division between sciences, though convenient, is arbitrary. The *rôle* of the philosopher is to develop generalisations and present them for verification by science. Hence the sphere of science is different from that of philosophy; and in the region of physical phenomena the deductive method has never been called in question. In conversation with Darwin, the lecturer was once speaking of the difficulties attendant on the interrogation of Nature, to which Darwin replied, "She will tell you a direct lie if she can"! It could not justly be said that Spencer was not an investigator at all; we were apt to forget that we stand on the shoulders of our predecessors, and to judge them by the standard of our own appliances and attainments. Of recent applications of the genuine deductive method, none was more remarkable than the quantitative biometric investigations originated by Sir Francis Galton, pursued by the late Prof. Weldon, and now being carried into various departments by numerous workers with conspicuous energy and success.

The lecture was listened to with marked interest by a large and representative audience, including the Vice-Chancellor of the University, with several professors and heads of colleges. It is published in full by the Clarendon Press.

THE WORK OF POLYTECHNIC INSTITUTES.

THE Lord Chief Justice, Lord Alverstone, G.C.M.G., P.C., distributed the prizes at the annual prize distribution at the Northampton Polytechnic Institute, London, E.C., on Thursday, December 8. In the course of his address, after the distribution of the prizes, he remarked that one reason why perhaps years ago we had fallen back was that this country and this metropolis had not then been aroused to the necessity of thoroughly good technical education, but that now immense good had been done to all the outlying districts of the metropolis, as well as to the City itself, by the establishment of the great polytechnics and by their capability for doing good work and of leading their students to higher and better grades. With reference to the proposed establishment of a great institution of technical optics in connection with the Northampton Polytechnic, he recalled a visit he paid years ago to the workshops of Messrs. Beck, and was satisfied that with the development of science that was now going forward practical optics would take a very prominent place in the future; he hoped that the polytechnic, with the support of those interested in it and the support of public bodies, would be able to say next year that the building of the new optical school had been commenced. It was always, he considered, a matter of regret when the educational facilities of any branch of technical industry were cribbed, cabin'd, and confined, and he further expressed the opinion that it was of very great importance that any school of practical technology or practical instruction in any expert business should be able to command the best apparatus and the best accommodation, because if it did not it would soon take second place. In these days specialisation is absolutely necessary in every trade, and after the preliminary training in fundamental subjects the time soon comes when specialisation must begin with the students, for in the present day it is no good scratching at a subject, but it must be gone through right to the bottom, so that the higher branches may be developed. Rapid modern developments, for instance, in electricity are constantly calling upon the institution for better apparatus, upon the teachers for greater acquirements, and upon the students for greater application.

After reference to the expenditure of some 6000*l.* on the new electric generating station, the Lord Chief Justice reminded the governors that they must be prepared for change if they desired to keep up the standard of the institution to the highest possible point. They must be on the look-out in each subject for the particular branches which can be specialised. In speaking to the students of the necessity for concentration on the object in view, he remarked that the extraordinary thing about Faraday was that he seemed to be able to think and think only of the particular subject that he was studying, and if he saw a light by the way which perhaps might lead him to some other aim or object he did not follow it up at once, but made a note, so to speak, in his mind, never forgetting the main object at which he was aiming, but putting a little mark so as to

come back some day and explore it. The address concluded with appreciative remarks regarding the social and recreative work of the institute, and especially with respect to the high place taken in gymnastics. The necessity for laying up for themselves a store of health and strength was strongly impressed upon the students, and the inestimable advantages of the social intercourse made possible by the existence of the various clubs and societies was insisted upon.

CERTAIN PHYSICAL CHARACTERS OF THE NEGROES OF THE CONGO FREE STATE AND NIGERIA.

IN a lecture at the Royal Anthropological Institute on November 29, Dr. Arthur Keith dealt with the physical characters and relationships of certain negro tribes in Equatorial Africa. His account was founded on data collected by (1) Mr. E. Torday amongst tribes in the Congo Free State, including the Bushonga, Basoka, Sango, and several others; (2) by Mr. P. A. Talbot in southern Nigeria, including the tribes of the Ekoi, Kabila, and Korawfs. Dr. Keith had also at his disposal three collections of crania, an extensive one of the Batatela (a tribe towards the eastern part of the Congo Free State), which was brought home by Mr. Torday; another from southern Nigeria, which he owed to Mr. P. A. Talbot; and a third (from the delta of the Niger) which had been placed at his disposal by Dr. Frank Corner.

In British Nigeria there are several types, but the one which he regarded as characteristic was represented by individuals of low stature, relatively long-headed, with the skull decidedly flattened from side to side. Many of the physical characters of this Nigerian type can be recognised in the Sango and other Congo tribes bordering on the Sudan. In head form, although not in stature, the Dinkas and Furs of the Nilotic tribes resemble the Nigerian type. In a contracted type which is prevalent in the Congo Free State, and which may be called the Congoese type, the head bulges laterally in the parietal region, and is relatively short and low.

The Batatela and the Basoka are representative of this type. It occurs also in some Nigerian tribes, and also in the Nyam-Nyam and Baran tribes of the Sudan. The Korawfs, a Nigerian tribe near the borders of the German Cameroons, are of a low stature with relatively long arms, as in Sir Harry Johnston's "forest negro type," but in head-form they resemble the Nigerian type of negro. The Bushongo from the south central part of the Congo Free State are tall compared with the Korawfs, but possess the massive head, great span, and large nose of the "forest type." In many features the Bushongo are related to certain of the Sudan tribes, such as the Nyam-Nyam. To account for the present distribution of physical characters among the negro tribes of Equatorial Africa one must assume that there has been a free intermigration of tribes, and that in their evolution the tendency in one tribe has been towards the accentuation of one set of features, in another tribe of another set of characters. Thus in the Nilotic Dinkas high stature and narrow-headedness have become marked characters; in typical Nigerians low stature and narrow heads; in the Bsoka a wide, short head and low stature; in the Buruna a wide head and high stature. Interbreeding may have played a part in the determination of tribal characters; if it had played a great part we should have found a greater degree of physical uniformity. The extent to which an admixture of Arab blood has modified the physical characters of negro tribes has probably been exaggerated.

SCIENCE AND THE STATE.[1]

IN all ages the welfare of a State must have been in a greater or less degree dependent on the development of its material resources and on the vigour and intelligence of its people; it is only in comparatively recent years, however, that recognition has been given to the fact that the State must leave nothing of this to chance, but must set itself deliberately by the use of scientific method to make the very best of its resources, and to increase the available vigour and intelligence of everyone within its borders. Not only so, but it must take suitable precautions that intelligence be universally trained, and be also duly organised so as to give the most effective and productive result. It is no longer enough that the State shall merely welcome and applaud a discoverer when he arises, or merely safeguard a private inventor from being fleeced; on the contrary, it must give of its substance to foster both discovery and invention, and must give legislative help to secure that inventions when made shall not be unfruitful through want of skilled labour or other hampering cause.

If we ask the reason for this change, the answer is that the keenness of international competition has vastly increased, that this has led to serious searching of intellect, that the laws of evolution have in consequence been seen to be applicable to nations as well as to individuals, and that under these inexorable laws the very existence of a State may be imperilled by ignorance or neglect. It is thus more important than ever that statesmen and leaders of the people shall not only be men of probity and high general character, but men of wide knowledge and penetrating forethought. They must have studied and must know all the possibilities of both land and people. On the material side they must have reckoned up the mineral resources, the agricultural resources, the water power and other forms of potential energy, the harbour accommodation, the waterways, and the advantages of the geographical position for over-sea commerce. On the human side they must have noted the natural gifts and weaknesses of the people, the best means of developing the former and of correcting the latter; and if it should be that there are varieties of race and colour in the population they must have thought out plans, not only for preventing loss of power through internal friction, but for obtaining the close cooperation of all the races in the general national interest. In the future it is only in a relative sense that there will continue to be "hewers of wood and drawers of water"; the State that aims at being in the forefront will have to see that even its wood-hewing and its water-drawing are done intelligently and to the best advantage. Further, the exploitation of any race in the interest of a higher race will be fatal folly when the need exists for exploiting all races in the interests of the State.

These considerations make it readily appear that the first great duty of the State towards science is to provide an effective and comprehensive system of national education. In the lower stages of the system direct and formal instruction in science need not bulk very largely; what is essential is that the pupil shall throughout his course be trained to observe, to think, and to reason. In the middle stages—the stages covered by secondary schools of all classes—the actual study of science, and especially of scientific method, must form a larger and ever-increasing part of the curriculum. Under neither of these heads, however, need we enter into detail to-night; it is sufficient for our present purpose to insist in connection with both on the desirability (1) of fostering rather than repressing the natural curiosity of the young; (2) of constantly recurring to the study of things in supplement to that of words; (3) of training the hands in the use of appropriate tools other than the pen; (4) of gradually introducing research methods into class-room work. It is the neglect of this advice that has been a main cause in the retardation of science; it has also helped to make school life a byword for dulness, and in many cases made the after-life unintellectual and even trivial.

When we come to the higher stages—the stage of the university, and more practical institutions coordinate therewith—the interest in our subject naturally increases, for there we look, not only for instruction in science and training in scientific method, but for a steady flow of fresh contributions to the stock of human knowledge. That this last is a legitimate expectation is now the received opinion throughout the whole civilised world. In accepting it, too, we have but returned to the original conception of a university—a conception that in the course of a long period of years had gradually come to be forgotten in English-speaking countries. The evil results of

[1] From the presidential address delivered before the South African Association for the Advancement of Science on October 31 by Dr. T. Muir, C.M.G., F.R.S.

this period of somnolescence at length became so striking, not to say alarming, that in May of 1870 a Royal Commission was appointed in England to make inquiry into the whole matter. It may safely be said that no stronger commission ever sat on a cognate subject, and that its long series of reports are models of clear statement and wise counsel which even to-day it would be difficult to improve upon.

"We have no doubt," one weighty report says, "that for a professor the duty of teaching is indispensable, but we agree that original research is a no less important part of his functions. The object of a university is to promote and to maintain learning and science, and scientific teaching of the highest kind can only be successfully carried on by persons who are themselves engaged in original research. If once a teacher ceases to be a learner it is difficult for him to maintain any freshness in the subject which he has to teach; and nothing is so likely to awaken the love of scientific inquiry in the mind of the student as the example of a teacher who shows his value for knowledge by making the advancement of it the principal business of his life." How far the great English universities then fell short of the ideal here indicated may be gathered from the writings of the time. On the monstrously developed examination system much of the blame had, of course, to be thrown. When it was asked what the universities did with their endowments and equipment, a voice from Cambridge said "they perform the functions, for too many of their students, of first-grade schools merely, and that in a manner about which opinions are divided; and superadded to these is an enormous examining engine, on the most approved Chinese model, always at work." Another writer advised that in order to be honest the university ought to put up a large brass plate with the inscription "Examinations held here"; and there were endless other well-deserved sarcasms from those who knew the facts best.

Of the agitation, the inquiry, and the plain speaking much good came, and the English universities of to-day show in consequence a very different character and spirit. The difference may not be all that earnest reformers still desire, but who in South Africa can with any conscience throw a stone at the offenders? Even so late as 1901, when numerous reforms had been effected in England, a great educationist and chemist, in directing attention to the function performed by universities on the continent of Europe, wound up with the passionate cry:—"Their universities have always been schools of research, of inquiry; unless, and until, ours become such, and our youth can be trained to advance, there can be no hope for us. God help us to make the change before it is too late!" If this be the prayer considered suitable for England when the present century began, what petition will suffice to-day for South Africa, which, as regards university research, stands well in the rear of the England of forty years ago? Are we to be encouraged to hope that one result of this year of union will be a serious effort to uproot our low ideals of university work, and to sow in their place the seeds of true learning and research? Fortunately, in one or two of the "colleges" a few individual teachers have set an excellent example, striving so far as their scant leisure permitted to advance the boundaries of their subject. All honour to them, and may more and more of their students imbibe their spirit and unite to press on the question of university reform and the removal of a deeply engrained stigma.

Coordinate in a sense with universities are public museums and libraries, the link of connection being that, besides intended for the promotion of research, they have other purposes to serve. All of them profess to aim at the instruction of the people; but in the case of museums and libraries this instruction is avowed to be mainly of a popular character, and in the case of museums it often differs very little from that more or less elevated amusement called sight-seeing.

As regards "museums," especially local museums, we have to note that, in the first place, very seldom have their founders had the purposes of real research in their minds. Usually, indeed, the original object has been the formation of a collection of animals, plants, and mere curiosities, with the result that if anything profited thereby it was natural history and archæology alone. Further, a fresh museum has almost uniformly been started without any intention of supplementing or cooperating with those already in existence; much loss in effectiveness has thus been sustained. How best to remedy these initial defects has been a long-standing problem with scientific men, and it is now fairly well agreed (1) that the museums of a country should for purposes of coordination and cooperation be under some common control; (2) that while in local museums appropriate specialisation should be encouraged, no science should be wholly neglected; (3) that both of the main purposes, instruction and research, should receive adequate attention in all museums; (4) that in the case of the central museum the purpose of research should be paramount, all the chief officers being chosen because of their ability to advance the knowledge of their own subjects. We in Cape Town have in the South African Museum, with its annals, a scientific agency of great national value and of immense promise for the future. Sad it is to think that, while its collections have been rapidly growing in magnitude and importance, the accommodation for exhibiting them remains as it was fifteen years ago.

As regards libraries, the state of matters is not greatly dissimilar. There are more of them it is true; but if the list be arranged in order of merit we have not got far down it when we find that we have parted company with scientific research. Indeed, the libraries that cater for anyone else than the so-called "general reader" are exceedingly few in number; cooperation is thus at least as necessary as in the case of museums. This is especially true in regard to scientific journals and the publications of scientific societies. The number of these is nowadays so great that a long purse is necessary for the maintenance of a complete collection; but by neglecting cooperation we make matters worse than they need be. Here in Cape Town, for example, we have four or five libraries that purchase scientific serials, and, though the libraries are within short distance of one another, duplicate and triplicate copies of some journals are to be found on their tables, while other journals equally important are neglected by them all. The time surely cannot be far distant when this will be rectified, when the importance of such reference libraries will be better appreciated by the State, and when the South African Public Library, having its special annual grant for reference books restored to it, will take the lead in a scheme of cooperation calculated to meet the wants of all engaged in scientific or literary research.

When thus dealing with the functions of universities, museums, and libraries, I have been in a manner viewing the State as an educationist. I now wish, in the same way, to invite your attention to the State as a landlord. With an extensive and varied property calling for development, one of the first and most urgent duties is to have it surveyed and inventoried under every needful heading. In the first place it must be accurately mapped; in the second place its surface constituents and rock formations must be ascertained and registered; in the third place the animal life of every district must be put on record; in the fourth place the same must be done with its plant life; and, lastly, its water supply, rainfall, and other climatic factors must be observed and tabulated. There thus arise as necessary scientific departments of the State's work—the topographical, geological, zoological, botanical, and meteorological. The fact that some of these subjects are incidentally dealt with by college lecturers and private students is no satisfactory reason for negligence on the part of the State. All such outside aid, it must be remembered, is subject to the uncertainties of personal liking, fashion, and caprice, and, consequently, is in its nature fitful and untrustworthy in an emergency. Besides, much of the work wanted to be done requires continuous attention over long periods, so that efficiency can only be secured by the existence of a permanent staff.

Attention has next to be directed to the State's duty in a third capacity, namely, as general health guardian. Fortunately this, though involving consideration of a number of sciences (entomology, bacteriology, mycology, &c.), need not be enlarged upon, it being self-evident that the bodily and mental fitness of the people is all-important in the life struggle of nations, and that it is almost equally momentous that animals and plants useful to man should be protected from the ravages of disease. Further, there

is the satisfactory reason that in dealing with such matters South African Governments have been, on the whole, sympathetic and, in some directions, markedly liberal. Here again, however, and perhaps in a special degree, it is necessary to give warning that the State should not burden itself with work proper to individuals and private corporations, but should confine itself to needful scientific work which other agencies cannot accomplish. It should never be forgotten that the State which discourages self-help is undermining its own strength.

Thus far we have been considering sciences with direct practical applications; indeed, the reasons for considering them at all has been in the main because of the existence of these applications—because the sciences bear more or less immediately on the welfare and prosperity of the State. What, then, are we to say of sciences from which the State or its people cannot hope to obtain any immediate benefit? Our answer is—and it ought to be given with entire frankness—such sciences must be content to take a second place. The State, we feel, has a perfect right to expect something tangible in return for its outlay; and, its supply of funds being limited, it is bound to pass in review before it any proposed series of scientific schemes, separating them out into practical and impractical, and thereafter sifting the practical into those that are urgent and those that are not. A manifest danger, however, besets the discriminators between rival schemes, it being far from easy to foresee what particular research will prove fruitful of practical applications and what will not. How often has one seen the pure mathematics of to-day change into the applied mathematics of to-morrow, and the previously despised insect collector being hailed shortly afterwards as a benefactor of mankind! All that one can hope for is that those with whom such decisions rest will always take the best advice available. Of recent years European Governments have tended more and more in such cases to consult their great leading scientific corporations; the Government of the Union may in like manner find our own Royal Society a willing and useful guide. I would merely add as a fact worth ruminating on that the States which have differentiated least between pure and applied science are the States which lead the world to-day.

While thus whole-heartedly urging the great importance of science on those who may be called to administer the affairs of State, it would be unfair to ignore the difficulties and troubles which well-disposed administrators are said to have experienced in their dealings with scientific men, or "experts," as they prefer to call them. The complaint of the most moderate of these critics is that the man of science is normally unpractical, and that his value to the State is marred by eccentricities due to over-study or excessive specialisation; and those critics who are not moderate, and who love a biting phrase better than strict accuracy, say that when he is not an astute self-seeker he is either a mooning pedant or a pernicious crank. Now in regard to this I should first wish to ask whether it be not the case that the failure of the scientific expert is often due to causes wholly outside himself. Time and again one has seen a man chosen for his high qualifications in a special branch of knowledge, and then set, not to the work of extending this knowledge by investigation, but to the absolutely diverse work of "running" a Government office or carrying on a purely business undertaking. Failure, nine times out of ten, is thus inevitable, so rare is it to find the successful student and the capable administrator combined in one. Surely it is the merest common sense to urge that if both sets of qualifications be wanted, reasonable care should be taken either that they are possessed by the same individual or that a practicable arrangement involving their separation has been previously devised. One thing certain is that in particular the appellation "self-seeking" as applied to men of science is singularly unfortunate, for, though the man of science with such a bent is not unknown, one's whole experience is that he is a comparative rarity, and that the more zeal a man has for science the less regardful he is of self. Indeed, it has been maintained that in the virtues of unselfishness and truthfulness the man who has chosen the pursuit of science for his life-work noteworthily excels. No less an authority than Helmholtz, himself a man of the world as well as a great investigator, has spontaneously testified to this, speaking with enthusiasm of the scientific man's "Sittenstrenge" and his "Uneigennützige Begeisterung." Unfortunately, it is possible that this "Sittenstrenge" is exactly what our public men would consider an eccentricity, their short-sightedness leading them to mistake a surface freckle for a deep-seated defect.

Be all this as it may, however, it is important to urge on both sides the fact that the man of science and the man of affairs, whatever their respective frailties may be, have need of each other, and must therefore in the future strive to know each other better, and learn to cooperate more effectively in the interest of the State. To this end he who aims at State administration must seek to possess other qualities and other aptitudes than those of the mere party politician, so that, besides doing his own proper work well, he may be the better able to gauge the value of pure scientific work, and be the better fitted to sympathise with the ideals and aspirations of even the extremest of specialists. On the other hand, the specialist must aim a little more at width of outlook and knowledge of men and affairs, must seek to moderate his exaggerated estimate of the importance of his own little domain, and must try to see good in the labours of other specialists in fields far distant from his own, never forgetting that all fields are but perfectly fitted portions of a cosmic whole, and that, as the botanist and the astronomer in particular must come to know,

Thou canst not stir a flower
Without troubling a star.

It would be a neglected opportunity if we did not note in passing that the need for a good understanding between the devotee of statecraft and the student of science is only part of a much wider need. Men who aspire to be leaders in municipal affairs, in commerce, in trade, in the manufacturing industries, in agriculture, must all come to know how substantially dependent they are upon science, and how, indeed, in a very real way, they must become more and more scientific themselves in the conduct of their affairs. With them also the day is gone when rule-of-thumb is a sufficient guide. Even sound common sense, so great a standby in the past, is no longer enough: what is wanted is that glorified form of common sense known as scientific method. Practical men in every line of life are beginning to see this, though they may not use the term. In plain language, what it means is the employment, at every stage of a process or undertaking, of the means best suited to attain the desired end. And as a method it is always essentially the same, no matter how the desired end may vary—whether the latter be, as we in Cape Colony have seen it to be, the sanitation of a town, the tracking of a crime, the repression of a native rebellion, the fighting of an invading disease, or the capturing of a market for fruit or wool. In all of these there was the same need for collecting accurate data, using all previously acquired relevant knowledge, planning skilfully a course of procedure, selecting wisely the human agents necessary, and then prosecuting with steady persistency the plan resolved on.

I need hardly say, in conclusion, that all that the most enlightened State can do will never be fully effective without a continuance of that zeal and devotion on the part of the "private worker" which has been so conspicuous in the past history of science; and, fortunately, in the course of evolution man has become so constituted that a stoppage of the supply need not be feared. Many will still be found willing and eager to work for the work's sake, whether the State does its duty or the reverse, merely resting on the assurance that "Nature never did betray the heart that truly 'loved her.'"

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The special board for biology and geology has adjudged the Walsingham medal for 1910 to A. V. Hill, of Trinity College, for his essay entitled "The Heat Produced by Living Tissues, with Special Reference to Muscular Activity"; and a second Walsingham medal to J. C. F. Fryer, of Gonville and Caius College, for his essay entitled "The Structure and Formation of Aldabra and Neighbouring Islands—with Notes on their Flora and Fauna."

The Vice-Chancellor gives notice that the Walsingham medal for 1911 will be awarded for a monograph or essay giving evidences of original research on any botanical, geological, or zoological subject, zoology being understood to include animal morphology and physiology. The regulations for the medal are published in the *Ordinances*, p. 629. The competition is open to graduates of the University who at the time fixed for sending in the essays are not of standing to be created Master of Arts. The essays for the ensuing year are to be sent to the chairman of the special board for biology and geology (Prof. Langley, The Museums) not later than October 10, 1911.

It is proposed to confer the degree of science, *honoris causa*, upon Prof. George E. Hale, director of the Solar Observatory of the Carnegie Institution of Washington, Mount Wilson, California.

The Earl of Lytton will distribute the prizes and certificates at the Borough Polytechnic Institute on Monday next, December 19, at 8 p.m.

A Reuter message from Kimberley states that the De Beers Company has made a donation of 25,000*l.* towards the founding of a South African university.

We learn from *Science* that Yale University has received an anonymous gift of 3000*l.*, the interest of which is to be used as an emergency loan fund in the interest of instructors and assistant professors of the University; 6000*l.* of a fund of 10,000*l.* left to the University by the late Mr. J. Burnett Collins, of Fort Worth, Texas; 4000*l.* from Mr. Newton Barney, of Farmington, Conn., toward the fund for the professorship of education, and a like amount from the family of the late Mr. John H. Whittemore, of Naugatuck, as a memorial gift. From the same source we learn that the University of Vermont has just received 5000*l.* by the will of Mr. Lewis L. Coburn, a graduate of the class of 1859.

The annual meeting of the Mathematical Association is to be held on January 11, 1911, at the London Day Training College, Southampton Row, London, W.C. At 11 a.m. the president, Prof. H. H. Turner, F.R.S., will deliver his address, and this will be followed by a paper on the teaching of mechanics by Mr. G. Goodwill. The business meeting will begin at 2 p.m., and will be followed by the reading of papers. The Rev. Canon J. M. Wilson will deal with two fragments of geometrical treatises found in Worcester Cathedral library, and Mr. C. V. Durell will take as his subject the arithmetic syllabus in secondary schools. A discussion on the report of the committee on the teaching of algebra and trigonometry will take place, and an exhibition of scientific apparatus and books will be held.

In connection with the Winter School of Agriculture of the Essex Education Committee, a course of instruction on farm crops and livestock is to be conducted at the County Laboratories, Chelmsford, from January 9 to March 17 of next year. The aim of the winter school is to impart instruction in the cultivation of the soil, the growth of crops, and the rearing of stock, based upon a knowledge of the sciences on which the practice of agriculture depends. The instruction in chemistry and physics, botany and zoology, is accompanied by practical laboratory work. The lectures on agriculture and surveying are supplemented by field and other demonstrations, but no instruction is given in the actual processes of farm work, it being held that these must be learnt upon the farm itself. The school, in fact, is intended to supplement farm training, not to replace it. The instruction is free to students resident in the County of Essex. Applications to attend must be made to the principal on or before December 16, from whom further particulars and forms of application may be had.

It is proposed to organise in London next July a holiday course of lectures for the advancement of commercial studies. The object of the lectures is to familiarise the students—mainly commercial men and teachers of economics from Continental countries—with the history and practical working of English commerce and industry. The lectures are being arranged by the International Society for Promoting Commercial Education, which has already held similar annual courses in Milan, Mannheim, Havre, and Vienna. The society receives the patronage and financial support of many European Governments. The London course is to be held at the School of Economics, Clare Market, London, W.C., from July 24 to August 12 next. Arrangements are being made for securing the assistance as lecturers of the most eminent British authorities on economic and commercial subjects, and promises of help have been received already. An influential committee is in course of formation, and the names will shortly be announced. Persons interested in the subject are invited to communicate with the organising secretary for Great Britain, Mr. E. Cleveland-Stevens, School of Economics, Clare Market, London, W.C.

The Education Committee of the General Medical Council has been considering for a year the place in a medical student's career that the preliminary sciences should occupy, and it has been engaged also in discussing the framing a pattern scheme showing how the subjects required could be studied adequately and the necessary examination passed within the prescribed period. The report of the committee was submitted to the General Medical Council at its winter session held at the end of November. The Education Committee has come to the conclusion that the schools of the country generally are not at the present time in a position to take up the work of preparing students in the preliminary sciences, chemistry, physics, and biology, and that the student must study these subjects at a medical school or science institute. The committee further came to the conclusion that any attempt to fix a standard minimum curriculum would fail, and eventually recommended only the elimination of some of the more junior examinations—which are recognised as preliminary examinations in general education—and their replacement by tests of an intermediate character. After some discussion, in which it was clear that there was a large body of opinion against the committee's recommendations, the further consideration of the subject was postponed until the May session of the council next year.

At a meeting of the governing body of the Imperial College of Science and Technology, held on December 9, it was decided to invite Prof. Friedrich Czapek, of the University of Prague, to occupy the newly founded chair of plant physiology and pathology in the college, and to take immediate steps to afford the accommodation necessary for the important work of such a department. It is understood that, in furtherance of the aim of the Imperial College to apply science to industry, this chair has been founded to meet the needs for training young men to act as advisers in matters connected with agriculture at home and in the Empire abroad. Under existing conditions of agriculture it is everywhere recognised—notably by the large planting communities—that the advice of scientific experts has become absolutely necessary. There is, in fact, a demand considerably exceeding the supply for the services of trained scientific men to act in these capacities. Prof. Czapek enjoys a world-wide reputation as one of the leaders in plant physiology and pathology, and he has devoted special attention to the biochemical aspect of these subjects. It is precisely from this biochemical treatment that results of the highest importance for industry may be expected. We are informed that the college has every reason to expect that Prof. Czapek will accept the invitation. It is anticipated that the recognition of the importance of the business interests wrapped up in this work will justify the authorities of the college in looking beyond their immediate resources for the heavy initial expense required for building and suitably equipping such a department and for its subsequent maintenance.

At the annual Convocation of the Allahabad University, held on November 12 at the Muir Central College, the Vice-Chancellor, Mr. Richards, conferred the degrees and delivered an address. Great strides, he said, have been made with the project for providing the University with a habitation of its own. The plans prepared by Sir Swinton Jacob will be on view in the exhibition shortly to open in Allahabad. The plans include a senate hall with offices and committee rooms, a law college, and a university library. When the buildings are completed they will amply provide for all the needs of Allahabad University. All the money needed for carrying out the whole scheme has not yet been collected, but with Government

assistance and the donations promised and received some Rs. 7,00,000 can be counted on. Further donations are urgently needed. Later the Vice-Chancellor said the University may congratulate itself upon a windfall that has come to it during the year. A sum of more than Rs. 75,000 has been received from the Queen Victoria Memorial Fund as an endowment for founding readerships for research work. The institution of university chairs was recommended by the Universities' Commission of 1904 for this very purpose, and it has been a cherished hope for many years that Allahabad University might be able to do something for the promotion of research among its graduate members. Hitherto, for lack of funds, nothing could be done. Now, however, a beginning can be made, and though it must be in a modest way at first, it inaugurates a new and important era in development; and as time goes on it will attract other benefactions, until the University has at length sufficient funds for research in all the directions of university study.

THE report on the work of the Department of Technology of the City and Guilds of London Institute for the session 1909–10 is now available. At the recent examinations 24,508 candidates were presented in technology from 418 centres in the United Kingdom, and of these 14,105 passed. By including the candidates from India and the colonies, and those for the teachers' certificates in manual training and domestic economy, the total number of examinees was 26,878. These figures show an increase on those of any previous year. In order to secure the expert advice of trade societies and professional bodies in the conduct of the department's educational work, the institute has arranged for the formation of advisory committees, consisting of persons interested in, and with a knowledge of, the technical details of different industries. The functions of each committee are to suggest improvements in the syllabuses of instruction, to recommend for appointment new examiners, and generally to advise on any matter connected with the course of instruction which may be referred to them by the institute. Reference has been made in former reports to the two main causes which impede progress in the technical instruction of artisans, and prevent the results of the teaching, now so liberally provided by local authorities, from being as satisfactory as might be desired. These causes are emphasised in the special reports of several of the institute's examiners. They are, first, the difficulty of finding competent teachers, and, secondly, the unduly large proportion of artisan students who enter technical classes without the preliminary knowledge necessary to take full advantage of the instruction they receive. While local authorities accept readily the advice and assistance of the department in their selection of teachers, and a higher standard of qualification is now more generally required, further improvement in this direction must be looked for if the money expended on technical instruction is to produce its best results. There can be no doubt that the teaching of technology has greatly improved during the past few years, but it must be noted that the examiners have still to direct attention repeatedly to the insufficient preliminary knowledge that some candidates possess.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, November 23.—Prof. W. W. Watts, F.R.S., president, in the chair.—Dr. W. F. **Hume**: The effects of secular oscillation in Egypt during the Eocene and Cretaceous periods. There is evidence of the gradual advance of the Cretaceous sea from north or north-east over Egypt during Upper Cretaceous times. Four stages in this advance are indicated by the distribution of the Cretaceous deposits. The four phases are:—(*a*) A north Egyptian type, in which the Nubian Sandstone entirely underlies fossiliferous beds of Cenomanian age. This extends across Egypt from Sinai to Baharia Oasis. (*b*) A Wadi-Qena type, developed near the head of the valley of that name, characterised by the alternation of Nubian Sandstone with fossiliferous Cretaceous beds. (*c*) A central Egyptian or Hammama type, in which the Nubian Sandstone forms the greater portion of the Cretaceous series, only the Danian and Campanian beds being fossiliferous limestones or shales. The Campanian beds are characterised by the presence of phosphatic fish-beds. (*d*) A south Egyptian type has resemblances to the central Egyptian, but in the Campanian the phosphatic beds are inconspicuous. As regards the transition from the Cretaceous to the Eocene, the existence of two types of strata at the base of the Eocene is noted: the first, the Luxor type, being fossiliferous, and developed in the Western Desert; the second, or Qena type, being unfossiliferous, and composed of white limestone similar to the Danian white limestone below them, but structurally different. These variations may be due to fold-effects produced while the land was gaining on the sea at the beginning of Eocene times, the Qena limestones being remade Cretaceous material. Whereas in southern Egypt Lower Eocene strata directly overlie the Danian strata, in northern Egypt unconformities exist between the Middle Eocene and the Cretaceous beds. The palæontological differences between the Cretaceous and the Eocene are recorded, the principal feature being the sudden incoming of the foraminifera Nummulites and Operculina. The distribution, zonation, and variation of the Eocene series are considered. The apparent uniformity of the fossiliferous Lower Eocene strata wherever developed is noted. The lack of uniformity in the Middle Eocene strata. The nature of the Eocene beds between Baharia Oasis and the depressions of Moela and the Fayum are described, zoned, and compared with the Middle Eocene in other parts of Egypt. The influence of the gain of land over sea is traced through the Upper Moqattam beds. The Cretaceous period in Egypt is marked by the gradual gain of sea over land; during the Eocene land appears to have been steadily gaining on the sea, probably accompanied by gentle fold-movements, which account for the minor differences in the nature of the Eocene deposits.—A. R. **Horwood**: The origin of the British Trias. During the Triassic period in Britain, deposition, it is maintained, was brought about solely by the action of water, and the British Trias is a delta-system, for during Carboniferous, Permian, and Triassic times deposition was mainly in the same area. There is a gradation from the Bunter to the Rhætic. The Bunter is known to be of fluviatile origin, and there is a continuity from Lower to Upper Trias, with an unconformity due to the new mode of formation and change in sedimentation. Oscillation and overlapping are admittedly due to aqueous agency. The Triassic outcrop and the delta-area of the river Mississippi are closely similar. Coloration is original, from below upwards, and not coincident with bedding. The thickness of the Bunter is an argument for a subsiding area. The ferruginous types in the Carboniferous, Permian, and Trias are alike due to delta conditions. The Trias is horizontal now, as originally, away from any ancient hills which it covers. It is only the skerries that are rippled. Screes occur mainly to the south-west of submerged hills. Sandstones thin out eastward, marls westward, and the skerries are on the hills. Rock-salt and gypsum are also horizontal and continuous in a linear direction. The Keuper gradually merges into the Rhætic phase, and the latter into the Lias. Since the Bunter sediments came from the north-west into the Midlands, so probably did the Upper Trias. Local metamorphic and volcanic rocks may have provided some of the heavier minerals, but, as a whole, their source was more distant. The flora and fauna can be grouped in provinces around the delta-head of the Trias. These considerations point to an aqueous mode of sedimentation in a moist and equable climate.

Physical Society, November 25.—Prof. H. L. Callendar F.R.S., president, in the chair.—Dr. A. **Russell**: The electric stress at which ionisation begins in air. Prof. J. B. Whitehead has published the values of the electric stress at which ionisation begins in air. His electrodes consisted of a metal tube and a cylindrical wire coaxial with it. Alternating pressures were employed, and the inner wires had diameters from 0·089 to 0·475 cm. If a be the radius of the inner wire, the expression $32+13{\cdot}4/\sqrt{a}$ gives all Whitehead's experimental results for the maximum electric stress in kilovolts per centimetre with a maximum inaccuracy of less than 1 per cent. Experiments show that the electric stress at which ionisation occurs is independent of the metals used for the electrodes

and of the inner radius of the outer tube. It depends on the radius of the inner wire. Steinmetz's experimental results on the sparking distances between parallel rods are in substantial agreement with Whitehead's figures. An empirical formula based on experimental results published by Kowalski and Rappel is given for the sparking voltages between equal spherical electrodes. The electric stress at the moment of discharge has a minimum value when the distance between the electrodes is a certain function of their radius. Great stress is laid on the currents of electrified air which stream round the electrodes before the discharge takes place. These currents often modify the values obtained for the disruptive stress at the moment of discharge. The similarity between the formulæ for the temperature gradient at the surface of a hot wire cooling in air and the empirical formula for the potential gradient at the surface of an electrified wire when ionisation is taking place at its surface is pointed out.—Prof. R. J. **Strutt**: The afterglow of electric discharge. When the electric discharge has passed at low pressure through certain gaseous mixtures, a luminosity survives for some seconds after the discharge has been turned off. An improved method of experimenting on the phenomena was introduced by Dewar. A powerful air-pump is used to draw a regulated current of gas through the vacuum tube. A continuous removal of the gas from the region of discharge is effected, and the afterglow which it emits, in passing through another vessel on its way to the pump, can be examined continuously and at leisure. There has been difference of opinion as to whether pure oxygen shows a glow or not. The glow, if any, is certainly exceedingly faint. With air a bright yellow glow is obtained, which is improved by enriching the air with oxygen. Pure nitrogen gives no glow whatever. Previous experimenters have connected the glow with ozone, though without expressing definite views as to what part ozone played. The evidence for this has been that the glow is only obtained where oxygen is present, and that it is destroyed by heat. Additional evidence has been obtained. (1) The glow cannot survive passage through a tube cooled in liquid air. This is regarded as due to condensation of ozone. (2) It is destroyed by passage over oxides of copper, manganese, and silver. Ozone is known to be destroyed by these substances. (3) While the glowing gas oxidises bright silver, the gas current beyond the point at which the glow has died out does not do so. Disappearance of the glow is simultaneous with disappearance of ozone from the gas. The glow involves consumption of ozone. It is natural to regard it as a flame of low temperature, arising from the oxidation of some other body by ozone. Experiments were made to determine the nature of this other body. A current of ozone from a vacuum tube fed with oxygen was allowed to mix with any other gas which it was desired to test on its way to the pump. Nitrogen or ordinary air added to the ozone gave no effect, but air which had been through an independent discharge, and had been deprived of its original glow by silver oxide, was found to glow again on mixing with ozone. Some body is produced in air by the discharge the oxidation of which is responsible for the glow. This body is nitric oxide. On leading a current of this gas into the ozone stream a brilliant glow was obtained of the characteristic yellow colour. This glow can be produced in the form of a pointed flame, with dark inner cone. The glow is not associated with a sensible rise of temperature. Condensing the ozone with liquid air, allowing it to re-evaporate, and admitting nitric oxide to it, a yellow flash can be obtained long after the electric discharge is over. The glow is purely chemical in its origin. Ozone from the Siemens tube used at atmospheric pressure seems incapable of yielding the glow when mixed with nitric oxide. This may be due to the low percentage of ozone present. The main conclusion is that the ordinary yellow afterglow is due to oxidation of nitric oxide by ozone.—L. F. **Richardson**: The approximate solution of various boundary problems by surface integration combined with freehand graphs.

Zoological Society, November 29.—Dr. H. Woodward F.R.S., vice-president, in the chair.—Dr. H. B. **Fantham** and Dr. H. Hammond **Smith**: A possible cause of pneumo-enteritis in the red grouse (*Lagopus scoticus*). The authors recorded that in grouse-chicks dying of coccidiosis, many of which showed symptoms of pneumonia, they found coccidian oöcysts in the bronchioles, bronchi, and trachea. The coccidian cysts in the bronchioles were probably capable of setting up sufficient irritation to account for the pneumonic symptoms. These observations were interesting as showing that the much criticised views of Klein, Tegetmeier, and others on "pneumo-enteritic" as a cause of mortality in grouse may have some foundation in fact.—Dr. J. F. **Gemmill**: The development of *Solaster endeca*, Forbes. The author described the ovaries and ova and the processes of spawning, fertilisation, segmentation, and gastrulation, and then dealt with the characters of the free-swimming larvæ and the changes related to the metamorphosis. He discussed the development of the internal cavities and of the skeleton, and described the methods he had employed in obtaining and rearing the larvæ. The memoir, in addition to details of adult anatomy, contained a description of various points in development.—F. E. **Beddard**: The alimentary tract of certain birds, and on the mesenteric relations of the intestinal loops. Notes the author had accumulated relative to the viscera of birds which had died in the society's gardens. The paper dealt more particularly with species that had not been carefully studied from the point of view of the convolutions of the intestine, and attention was directed to a considerable series of birds.—Prof. A. **Cabrera**: The specimens of spotted hyænas in the British Museum (Natural History). Three apparently new forms were described.

Linnean Society, December 1.—Dr. D. H. Scott, F.R.S., president, in the chair.—Captain C. F. **Meek**: The spermatogenesis of *Stenobothrus viridulus*, with special reference to the heterotropic chromosome as a sex determinant in grasshoppers.

Mathematical Society, December 8.—Dr. H. F. Baker, president, in the chair.—G. H. **Hardy**: Properties of logarithmico-exponential functions.—G. H. **Hardy**: Some results concerning the increase of functions defined by an algebraic differential equation of the first order.—A. A. **Robb**: Optical geometry of motion.—T. C. **Lewis**: Note on the Pellian equation.—G. B. **Mathews**: The arithmetical theory of binary cubic forms.—Dr. W. H. **Young**: The integration of Fourier's series.—Dr. W. H. **Young**: The theory of the application of expansions to definite integrals.

Royal Astronomical Society, December 9.—Sir David Gill, K.C.B., president, in the chair.—A. C. D. **Crommelin**: Note on Mr. Innes's paper on the mean or perihelion distances of comets.—A. Stanley **Williams**: The equatorial current of Jupiter in 1880. The author concluded from observations of eight spots that the rotation period of the equatorial current in 1880–1 was nearly 20 sec. shorter than during the years 1888–1908, amounting to a difference in velocity of about 15 miles an hour.—A. A. **Rambaut**: Observations of Halley's comet, Daniel's comet (1909*e*), and comet 1910*e*, made at the Radcliffe Observatory, Oxford.—A. A. **Rambaut**: Observations of stars occulted by the moon during the eclipse of 1910 November 16. A photograph of the eclipsed moon and trails of stars was shown, the telescope having been adjusted to the moon's motion during the eclipse.—C. V. L. **Charlier**: Multiple solutions in the determination of orbits from three observations. The author showed that in certain regions more than one solution could be obtained from the observations, while in others only one was possible; in consequence of this, much difficulty was somtimes found in obtaining the true orbit, as was the case with comet 1910*a*.—H. H. **Turner**: The accuracy of the positions of the star images in the "Harvard Sky." By the latter term was intended the Harvard series of fifty-five plates, forming a photographic map of the heavens on a scale about one-eleventh that of the Astrographic Catalogue. Formulæ were given for computing the optical distortion, varying as the cube of the distance from the centre of the plates, and also for the differential refraction.—S. A. **Saunder**: The determination of selenographic positions, and the measurement of lunar photo-

graphs. Fifth paper: Results of the measurement of two Yerkes negatives. The negatives, taken by Prof. Ritchey, were extremely fine, but their dates—given as 1901 August 3 and November 21—were uncertain. The result of the author's reduction of the measures of the plates enabled him to show that they were actually taken on September 3 and November 20. The measures appeared to show that points on the moon greatly above or below the mean surface should be rejected, owing to their being shifted in opposite directions by libration. A diagram was drawn to exhibit the close agreement between points independently measured on photographs by Prof. Franz and Mr. Saunder compared with the considerable divergence in the positions of the same points as determined by Lohrmann and Mädler. The actual measures had been made on the negatives by Mr. Hardcastle.

PARIS.

Academy of Sciences, December 3.—M. Émile Picard in the chair.—G. **Lippmann**: Two pieces of metal lightly touching do not, in general, form an electrical contact when the difference of potential is small. Two forms of contact are described in which no pressure is necessary. In one of these a strip of paper moistened with a solution of an electrolyte (calcium chloride) is employed; the second consists of two amalgamated silver wires.—A. **Gautier**: Concerning the invention of porous filtering candles. The author points out that he described the manufacture and use of porous porcelain filters two years before Ch. Chamberland.—A. **Laveran** and A. **Pettit**: A new hæmogregarian of *Damonia subtrijuga*.—M. **Gouy**: The potential of the discharge in a magnetic field. —W. **Kilian** and M. **Gignoux**: The levels of the pebble beds and terraces in the neighbourhood of Saint-Rambert-d'Albon (Drôme) and of Beaurepaire (Isère).—M. Lecornu was elected a member in the section of mechanics in the place of the late M. Maurice Levy.—G. D. **Boerlage**: An attempt at "*vol à vortex.*" Attention is directed to the effect of the thickness of the front edge of the wing in birds, and the author suggests that an attempt might be made to realise these conditions in aëroplanes.—M. **Lambert**: A form of the equations of motion of a small planet.—M. **Borrelly**: Observations of the new Cerulli comet made at the Observatory of Marseilles with the comet finder. Data are given for November 10, 12, 14, and 16.—M. **Coggia**: Observations of the Faye comet (1910*e*, Cerulli, November 9) made at the Observatory of Marseilles with the Eichens equatorial of 26-cm. aperture. Positions are given for November 12 and 16.—P. E. **Gau**: The integration, by the method of M. Darboux, of any partial differential equation of the second order.—T. **Lalesco**: The poles of resolving nuclei.—Henri **Villat**: The movements of a fluid round an obstacle of given form. —Marcel **Chopin**: The absolute measurement of currents of great intensity. A description of a modified tangent galvanometer capable of measuring currents up to 1000 amperes.—M. **Tian**: The nature of the decomposition of hydrogen peroxide solutions produced by light. It has been shown that the decomposition of hydrogen peroxide by heat is a bimolecular reaction, whilst the decomposition by catalysis in presence of colloidal platinum, diastase, &c., is a unimolecular reaction. An experimental study of the decomposition produced by ultra-violet light shows that the reaction is unimolecular, and hence is not analogous to the action of heat, but rather resembles catalytic decomposition.—Paul **Jégou**: The reception of the Hertzian time signal from the Eiffel Tower. The apparatus described and illustrated works with Leclanche cells instead of secondary batteries, and is simplified in other directions.—L. **Décombe**: The mechanical interpretation of the principle of Carnot and Clausius. The case of a compensated transformation.—F. **Charron**: The modifications produced by the air layer in friction and sliding between solid bodies.—Br. **Glatzel**: New experiments in stimulation by shocks in wireless telegraphy. It is well known that by interposing very short sparks into the primary circuit of a Hertzian wave excitor the vibrations in this circuit are effectually deadened. The author passes the sparks through a tube containing hydrogen between nickel electrodes. Reproductions of photographs are given showing the complete damping effect obtained. —R. **Marcelin**: The mechanics of irreversible phenomena.—A. **Besson** and L. **Fournier**: By passing a rapid current of hydrogen bromide over amorphous silicon at a red heat a liquid is obtained which, on submitting to fractional distillation, gives as the main product of the reaction silicon tetrabromide; small quantities of SiH_2Br_2 are also obtained, and also a liquid which appears to be a mixture of this with SiH_3Br. Details are also given of a rapid method of preparing a crude silicon suitable for the reaction. By the action of the silent discharge upon the vapours of the silicobromoform four substances were identified, $SiBr_4$, Si_2Br_6, Si_3Br_8, and Si_4Br_{10}, the silicon analogues of tetrabromomethane, octobrompropane, and decabrombutane.—E. A. **Salmon**: A method for producing a reaction between two bodies in the electric arc.—L. **Tchougaeff** and W. **Fomin**: The addition of hydrogen to the isomeric thujenes and sabinene. The application of the Sabatier and Senderens reactions having been shown to be too energetic in the case of these two hydrocarbons, the addition of two atoms of hydrogen to each molecule was effected by the catalytic action of platinum black, the hydrogen being used under a pressure of 25 to 50 atmospheres. The physical and chemical properties of the resulting hydrocarbons are given.—Georges **Denigès**: A new reaction of morphine. The reagent proposed is a mixture of ammonia, hydrogen peroxide, and copper sulphate in aqueous solution. A red colour is produced if the concentration of the morphine is above 0·03 gram per litre. This reaction gives negative results with codeine, thebaine, papaverine, narceine, and narcotine.—A. **Verneuil**: The nature of the oxides causing the coloration of the Oriental sapphire. Careful analyses of sapphires from different sources (Montana, Burmah, and Australia) showed the invariable constituents to be oxide of iron and oxide of titanium. The latter oxide was not detected in the earlier analyses by other workers. No chromium was found in the two sapphires examined for this element, and the author concludes that chromium is not essential to the production of the characteristic colour. The conclusion that the colour is due to the oxides of titanium and iron alone is confirmed by the synthesis of the gem by fusion previously described.—Henri **Coupin**: The influence of various volatile substances on the higher plants.—L. **Moreau** and E. **Vinet**: Insecticide treatments in viticulture.—Ed. **Griffon**: The influence of the tarring of roads on the adjacent vegetation. The author comes to the conclusion that no injurious effect to vegetation can be proved to have been caused by the tarring of roads. Laboratory results cannot be regarded as conclusive on this point, which can only be settled by actual practice in the open air.—MM. **Melchissédec** and **Frossard**: Muscular fatigue in singing.—M. **Doyon**: The formation of antirhombine in the liver previously frozen at a very low temperature.—G. **Linossier**: The influence of iron on the formation of the spores of *Aspergillus niger*. It has been shown by previous workers that if iron be omitted from the culture solutions of *Aspergillus niger* spores are not formed. The author has extracted the black pigment from the spores of this mould, and shows that it possesses properties resembling the hæmatin of the blood, and contains iron as an essential constituent. This furnishes a full explanation of the impossibility of producing spores in the absence of iron.—Gabriel **Bertrand** and Arthur **Compton**: The influence of temperature on the activity of cellase. Cellase from sweet almonds has a maximum activity at a temperature of 46° C. This is independent of the duration of heating, and is a specific value of great interest.—M. **Lemoine**: The presence of deposits of cholesterol in the coats of sclero-ætheromatous arteries.—Ch. **Vélain** and Albert **Michel-Lévy**: The primary strata of the south of the Vosges.—MM. **Bernard** and **Mougin**: The stratification of the *névé* and of the ice in the upper regions of the collecting areas of glaciers.—Ph. **Glangeaud**: The glacial phenomena in the mountains of Forez.—Paul **Bertrand**: General characters of the stipes of *Asterochlaena laxa*.—M. **Martel**: The removal of obstruction in water-bearing fissures.—P. **Mercanton**: The magnetic condition of the diabases of Isfjord at Spitsbergen.—Louis **Gentil**: The lower Mlouya (eastern Morocco).

NEW SOUTH WALES.

Linnean Society, September 28.—Mr. C. Hedley, president, in the chair.—C. T. **Musson** and W. M. **Carne**: The adventitious roots of *Melaleuca linariifolia*, Sm.—R. J. **Tillyard**: Some experiments with dragon-fly larvæ. This paper embodies the results of experiments carried out with the object of showing:—(1) That dragon-fly larvæ of certain kinds live longer than one year. An unknown Libellulid larva taken at Heathcote on October 10, 1908, and more than half-grown then, has lived in an aquarium to the present date. It now appears full-fed, and may be expected to emerge this season. Its age, from the egg, must be more than two and a half years. (2) That certain dragon-fly larvæ can resist severe and prolonged drought. Eight larvæ of *Synthemis eustalacta*, Burm., were placed in a shallow-water aquarium over sand; no food given from December 25, 1909, and water allowed to evaporate. The aquarium was dry on February 2, and the larvæ were kept alive, hidden in the sand, until May 29, a period of nearly four months. The larvæ were then returned to water and fed up. Seven are still alive, and may be expected to emerge this season.—T. Harvey **Johnston** and Dr. J. Burton **Cleland**: The Hæmatozoa of Australian Reptilia. No. 1. A list of Australian reptiles from which Hæmatozoa have been recorded is given, and three species of Haemogregarina (Karyolysus) are described as new.

October 26.—Mr. C. Hedley, president, in the chair.—T. **Iredale**: An additional note on the birds of Lord Howe and Norfolk Islands. The opportunity of inspecting the Watling drawings in the British Museum prompted the author to investigate the authenticity of the early chronicles relating to some of the birds of Norfolk and Lord Howe Islands, now extinct, or the identity of which has never been settled satisfactorily. From the consideration of the historical evidence available, the author concludes that the extinct white gallinule (*Notornis alba*) was restricted to Lord Howe Island; that the "Norfolk Island petrel" of Latham is probably *Puffinus griseus*, Gm., which still breeds about the typical locality, and not *P. chlororhynchus*, Less., as supposed by the late Dr. Sharpe; and that drawing No. 282, regarded by Dr. Sharpe as representing *P. tenuirostris*, Temm., is undoubtedly a figure of the Œstrelata still breeding, or which apparently used to breed, on Norfolk Island, which must bear the name *Œstrelata phillipi*, Gray, and which is different from *Œ. neglecta*, Schl. Some omissions are rectified, and observations supplementary to those of Mr. Hull (Proceedings, 1909, p. 636) are given.—A. F. Basset **Hull**: Further notes on the birds of Lord Howe and Norfolk Islands, with the description of a new species of petrel. The author endeavours to dispel the uncertainty enshrouding the identification of the petrels of Norfolk Island. Captain Hunter's "bird of providence" remains a mystery, as visits to Mount Pitt in November, and in the succeeding year in August, offered no signs of birds or burrows, a condition of things possibly due to the extermination of the old-time colony, or its removal to more secure breeding grounds. The "Big Hill mutton-bird" of Lord Howe Island, which breeds upon Mount Gower, is shown to be markedly different from *Œstrelata neglecta*, Schlg., and is described as new.—J. H. **Maiden** and E. **Betche**: Notes from the Botanic Gardens, Sydney. No. 16.—A. M. **Lea**: Australian and Tasmanian Pselaphidæ (Coleoptera).

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 15.

LINNEAN SOCIETY, at 8.—Reports on the International Botanical Congress at Brussels, 1910: Dr. Otto Stapf, F.R.S., and others.—Non-calcareous Sponges from the Red Sea, collected by Mr. Cyril Crossland: R. W. H. Row.—Comparative Anatomy of Leaves of Veronica: R. S. Adamson.

ROYAL SOCIETY OF ARTS, at 4.30.—The Taj Mahal and its Relation to Indian Architecture: R. F. Chisholm.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Submarine Cables for Long Distance Telephone Circuits: Major W. A. J. O'Meara, C.M.G.

FRIDAY, DECEMBER 16.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Production of Castings to withstand High Pressures: Prof. H. C. H. Carpenter and C. A. Edwards.—The Constitution of Troostite and the Tempering of Steel: Andrew McCance.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Mathematical Deduction of the most Economical Ratio of Reinforcement for Reinforced-concrete Structures: R. N. Mirza.

SATURDAY, DECEMBER 17.

ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.—Notes on a "Neolithic Floor" near Rayleigh, Essex: F. W. Reader and S. Hazzledine Warren.—Sarsens, Basalt, and other Boulders in Essex: Dr. E. A. Salter.

MONDAY, DECEMBER 19.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The French Antarctic Expedition, 1909–1910: Dr. J. B. Charcot.

INSTITUTE OF ACTUARIES, at 5.—On the Valuation of the Liabilities of an Insurance Company under its Employers' Liability Contracts: W. Penman, JR.

TUESDAY, DECEMBER 20.

ROYAL STATISTICAL SOCIETY, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Winning of Coastal Lands in Holland: A. E. Carey.

WEDNESDAY, DECEMBER 21.

GEOLOGICAL SOCIETY, at 8.—The Keuper Marls around Charnwood Forest: T. O. Bosworth.—The Relationship of the Permian to the Trias in Nottinghamshire: R. L. Sherlock.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Modern Methods of Research on a Scientific Cruiser: Arthur Earland.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—(1) Report on Balloon Experiments at Blackpool, 1910; (2) The Meteorological Significance of Small Wind and Pressure Variations: Capt. C. H. Ley.—Atmospheric Waves of Short Period: Dr. Wilhelm Schmidt.

CONTENTS.

THURSDAY, DECEMBER 22, 1910.

PROBLEMS OF CROWN COLONY ADMINISTRATION.

The Broad Stone of Empire. Problems of Crown Colony Administration, with Records of Personal Experience. By Sir Charles Bruce, G.C.M.G. Vol. i., pp. xxxiv+511+2 maps. Vol ii., pp. viii+555+4 maps. (London: Macmillan and Co., Ltd., 1910.) Price 30*s.* net, two vols.

According to the description on the title-page, this book purports to discuss problems of Crown Colony administration, and to contain, as a subsidiary matter, records of personal experience. The first volume carries out, on the whole, the promise of the title-page, but the second is in effect a record of Sir Charles Bruce's *acta et verba* during the thirty-six years of his faithful and efficient public service in Ceylon, British Guiana, the West Indies, and Mauritius; and the discussion of problems of Crown Colony administration forms little more than a setting for the account of his experiences, and of the recognition which his valuable services deservedly received, from time to time, at the hands of his official superiors. Lengthy despatches and memoranda, much of which might with advantage have been omitted and the rest severely condensed, encumber the pages of the book, and were it not that it is provided with an excellent index, its undoubted value as a work of reference for students of colonial administration would be gravely compromised.

The book, which extends to some 1100 pages, after discussing the resources of the Crown Colonies, and British policy in connection with them, under the heads of national, colonial, and imperial, treats of the Colonial Office and the Colonial Governor; and there are chapters on law, labour, race, health, education, religion, agriculture, forestry, commerce, finance, transport, meteorology, imperial communications, fiscal system, expansion, defence, and the Crown. There are seven appendices, of which two, namely Mr. Edward Manson's memorandum on systems of law obtaining in the Crown Colonies, and a memorandum on measures to be carried out for prevention of malarial fever in Mauritius, are of special interest to students of Crown Colony administration, and, as already mentioned, there is an excellent index.

Within the limits of a short review it is not possible to discuss more than one or two of the subjects with which the author deals; it must suffice to indicate the rest, and to say that (apart from a certain discursiveness and from the other drawbacks to which we have felt bound to direct attention), the student of problems of Crown Colony administration will find much in the various chapters to reward his industry and to satisfy his curiosity. To the readers of NATURE the chapters on agriculture and on forestry, the chapter on meteorology, and the two chapters on health, will probably be of the greater interest than the others. The description of the work of the Imperial Department of Agriculture in the West Indies, which has done so much during the last ten years towards helping to restore the prosperity of the West Indian Colonies is interesting; the sketch of the progress of agriculture in Ceylon is instructive; and the chapter on forestry shows of what vital importance are conservation of forests and reafforestation, and how much remains to be done in that regard. The chapter on meteorology is practically confined to an account, interesting so far as it goes, of the work done under the auspices of Dr. Meldrum at the Mauritius Observatory. The most interesting chapters of all are the chapters on "Health." Only those who have lived in unhealthy climates can fully realise of what vital importance it is to the progress of a community that effectual means should be found for combating the diseases which in so many of the most fertile of the British Dominions beyond the seas have so hampered what Sir Charles Bruce well calls the "agencies of beneficial occupation"—industry, commerce, military and naval defence, and good government—and how dependent those agencies are on the preservation of health against tropical diseases. In this field of later years science has rendered yeoman service to the State, and to the pioneers of civilisation and progress in the tropical and subtropical dependencies of the Crown, and, indeed, throughout the world. Malaria is no longer an elusive bogey; yellow fever has lost much of its terrors; even plague and cholera, in communities which have been brought to understand the value and necessity of the precautionary measures prescribed by science, can be successfully combated and brought under control.

Yellow fever has been practically banished from its hot-bed, Havana. The isthmus of Panama, which is credited with having killed one workman for every sleeper of the Panama Railway, is no longer a particularly risky place of residence. Our garrison and fleet at Malta no longer suffer from Malta fever. Ismailia, formerly a hot-bed of malaria, has been rendered perfectly healthy. The dreaded sleeping sickness, although no absolute cure has yet been found for it, has, in Uganda, at all events, been brought under control. It is unnecessary to multiply instances. And apart from what has been done in the matter of prevention and cure of diseases which affect mankind, the labours of the bacteriologist, protozoologist, entomologist, and helminthologist have contributed in no small degree to the progress and prosperity of the tropical and subtropical colonies. This has been done by discovering and tracing the life-history and development of the lower forms of life which are the cause of many of the fatal diseases to which stock, especially in tropical and subtropical lands, are subject, in tracing out the means by which they are communicated, and the life-history of their transmitters, or intermediate hosts, in devising preventive measures, and preparing vaccines or serums, and searching for and discovering drugs which act as prophylactics or as cures.

The two branches of scientific inquiry—as regards human disease, and as regards diseases of animals—are, indeed, to a great extent interdependent. The discovery of the trypanosome of nagana in cattle and of its transmission by *Glossina morsitans* may be said to have pointed to the discovery of the transmission

of the trypanosome of sleeping sickness to man by *G. palpalis*. The discovery that the trypanosome of sleeping sickness persists and grows in *G. palpalis* is akin to the discovery of the development of the malaria parasite in the anopheles. The discovery of the transmission of the piroplasma of Texas fever, of East Coast fever, and of "biliary fever" in stock, by means of ticks, pointed the way to the discovery of the transmission by ticks to man of the spirillum of relapsing fever. There may be some reason to hope that the exhaustive investigation of the causes of grouse disease which is now in progress may possibly lead to a better understanding of the causes of appendicitis in the human subject. Many similar instances might be mentioned. But this is not the place for an essay on the recent history of bacteriology.

Much yet remains to be done. The cause of and specific remedy for blackwater fever, that scourge of tropical Africa, is still to seek. An effectual remedy for sleeping sickness still makes itself desired. Leprosy still baffles the investigator. No cure for bilharzia has yet been found. Prophylaxis for horse-sickness amongst horses, hitherto baffled by hæmolysis, has still to be discovered. (For mules a fairly satisfactory prophylactic has been found.) Piroplasma, for which, in dogs, a specific cure has been discovered, in horses and cattle still presents an unsolved problem.

But the future is full of hope. Such great strides in advance have been made during the last few years that no difficulty seems, to the investigator, to be insuperable. Perhaps the most interesting of the later developments is the discovery of a series of facts which point to the probability of the terribly fatal fever, hitherto called malaria, on the west coast of Africa, being really a form of yellow fever. This matter is now, or is shortly, about to be brought under exhaustive investigation; and should the probability turn out to be a reality, the adoption on the Coast of precautions similar to those which have proved so successful on the isthmus of Panama should render the Gold Coast as healthy as Barbados. Small wonder that an influentially signed address has been sent to the Memorial Committee, suggesting that the name of our beloved Sovereign, the late King Edward the Seventh, cannot be better commemorated than by a liberal endowment of the schools of tropical medicine, which in these later years have done so much for the promotion of bacteriological research and the prophylaxis and cure of tropical diseases, both in the United Kingdom and in the British Dominions beyond the seas.

THE MICROSCOPE AS AN OPTICAL INSTRUMENT.

Microscopy. The Construction, Theory, and Use of the Microscope. By E. J. Spitta. Second edition. Pp. xxii+502+xvi plates. (London: J. Murray, 1910.) Price 12*s.* 6*d.* net.

THE views expressed in the previous notice of this work which appeared in NATURE (February 6, 1908) would appear to have been amply borne out in the welcome accorded to it by the public, since a second edition has already become necessary. Continued use of the volume as a book of reference has thoroughly confirmed the original opinion formed as to its value for the purposes of the practical microscopist. While much more limited in scope than the classical work of Carpenter and Dallinger, being restricted to the consideration of the microscope as an optical instrument, it has from this point of view already largely superseded the older work. Dr. Spitta is fortunate, too, in having obtained, in dealing with the more theoretical portions of the subject, the assistance of Mr. Conrady, whose excellent mathematical knowledge has helped to keep the book free from any of the remarkable theories in connection with the microscope which have been put forward in recent years, and have even found acceptance from some skilled practical microscopists.

One of the features of the first edition of the book was that it was well up-to-date in the account given of present-day microscopes and microscope construction and accessories. There was thus the less necessity for changes in a new edition appearing after such a comparatively short interval. Nevertheless, besides the one or two more important additions of which mention is made below, advantage has been taken of the opportunity offered to include some of the most recent work. Old illustrations of microscopes by prominent makers have been replaced by others of the newest types, and descriptions of novel accessory apparatus are given. We note that the name of the Spencer Lens Co., of Buffalo, N.Y., now appears for the first time, their stand for critical work being fully illustrated, and attention is directed to their one-sixth objective with specially long working distance (1 mm.). A new sixth by Watson and Sons, and one by Reichert, with extra long working distance, are also mentioned. Illustrations of newer models by Zeiss, Beck, and Watson take the place of those previously given, and some forms of museum microscopes, with mechanical contrivances for bringing a series of slides successively into the field of view, are now described.

Among additional accessory apparatus may be mentioned the simple form of apertometer devised by Mr. F. J. Cheshire; new illuminators, especially the convenient miniature arc lamp by Leitz; Mr. J. W. Gordon's lamp with glass-rod light collector, and Mr. J. E. Barnard's mercury-vapour lamp for microscopists—very convenient, with screens, for obtaining monochromatic light; a new auxiliary stage by Watson and Sons; forms of gauges for measuring the thicknesses of cover glasses and slips; measuring oculars or eyepiece micrometers; and a simplified apparatus and method of preparing metallurgical specimens for microscopical examination. The last would appear to be outside the limits of the work, which does not deal with the extensive subject of the preparation of specimens. We have noted also a number of changes in the text, whether by way of omission of unnecessary matter, or additions to render explanations clearer. It is interesting that Dr. Spitta appears finally to have come to the conclusion, with reference to the "black dot" and "white dot" effects in pleurosigma, that "the better the combination (objective) the better the rendering of the black dot effect, no matter the appearance, within reasonable limits, of the white one."

We would remark also that in his chapter on the "Theories of Microscopical Vision," Mr. Conrady adds a few paragraphs giving a short account of the connection between N.A. and the vision of minute objects of dimensions below the resolution limit, whether self-luminous or opaque.

The more important additions are those which deal with the extension of dark ground illumination to high powers, and the description of Siedentopf's apparatus for viewing ultra-microscopic particles. Dark ground illumination at high powers is obtained by the use of a condenser or illuminator of special type, which brings the light, usually with the aid of side reflection, to a focus on the specimen at a very oblique angle. Types of such condensers by Leitz, Zeiss, and Beck are described, and the method will no doubt be of value to the bacteriologist.

The Siedentopf method for illuminating ultra-microscopic particles is well known. The subject perhaps lies outside the range of the ordinary microscopist.

Finally, it may be mentioned that the already excellent series of photomicrographs has been extended by the introduction of four or five interesting photographs of amphipleura. Unfortunately, in the copy we have seen, the printers have made the mistake of printing the descriptive text on the wrong side of the thin paper separating the plates, with the result of making it somewhat difficult to read.

GEOMETRY OF SURFACES.

A Treatise on the Geometry of Surfaces. By A. B. Basset, F.R.S. Pp. xvi+291. (Cambridge: Deighton Bell and Co.; London: G. Bell and Sons, 1910.) Price 10s. 6d.

ACCORDING to his preface, Mr. Basset intends this book to supply a want in English works on solid geometry, namely, an adequate account of surfaces other than quadrics, the existing gap being due to the fact that Salmon's "Geometry of Three Dimensions" is now out of print.

The greater part of the book seems to be devoted to a detailed examination of the various types of singularities which can occur in surfaces of order not higher than the fourth; such a lengthy investigation cannot be properly criticised except at the cost of great labour. But, for reasons given below, it is doubtful if the method adopted for resolving higher singularities is really sufficient to do all that is claimed by the author.

It is not altogether clear, either, for what class of readers the book is intended; the greater part of the results will interest none but specialists in geometry. And one may imagine that such specialists might be tempted to ask why the analytical machinery is developed purely from metrical definitions, when the properties to be established are mainly projective (or descriptive) in character. Thus, *reciprocation* seems always to refer to a *sphere,* and *homogeneous coordinates* are defined (§3) only as *perpendiculars* on the faces of a tetrahedron. It is not quite easy to see how Mr. Basset would justify the use of coordinates such as $x+iy$, $x-iy$, on the last definition.

However, there is probably a wider circle of readers, not claiming to be geometrical specialists, who would take an intelligent interest in an account of the properties of cubic and quartic curves and surfaces, and particularly in results which are related to work in other subjects. Such readers might also find it useful to have information as to various models available for the illustration of the shapes of the figures; doubtless the expert geometer disdains these mental crutches, and relies on his powers of intuition. But those of us who confess to finding it difficult to visualise surfaces from their equations, are able to point to geometrical experts who have been led to unexpected results by the consideration of models; one need only mention Kummer's model of the surface of centres of an ellipsoid (Salmon, "Geometry of Three Dimensions," p. 273), and Henrici's models of movable hyperboloids. Even expert analysts may make slips in their work, and may find occasionally some difficulty in detecting such slips, while an examination of a diagram or model will often indicate the mistake at once. An illustration may be drawn from Mr. Basset's statement (§142) that the circles of curvature at the ends of the minor axis of an ellipse can intersect at points which lie on the circles of curvature at the ends of the major axis; a moment's glance at a figure will show that the former circles lie wholly *outside,* the latter wholly *inside* the ellipse, for all values of the eccentricity.

Those who wish for an introductory account of the simpler properties of cubic and quartic curves will find Mr. Basset's provision for them rather scanty. His theorems (and proofs) occupy but little more space than the summary (of results only) given in Pascal's "Repertorio," t. ii. (1st edition); and some of Pascal's references are omitted from the list (for cubic curves) given on p. 100. A good deal of light would be thrown on the classification of quartics of the first species by a reference to the Sylvester-Weierstrass method of invariant factors. The same method would prove useful in handling cyclides (quartic surfaces), and leading up to Darboux's pentaspherical coordinates; as Darboux's coordinates are not introduced at all, Mr. Basset is unable to prove that confocal cyclides cut orthogonally, and various other theorems given in Salmon's account of cyclides have to be omitted also.

Nor will the inquirer after the arrangement of the twenty-seven lines on a cubic surface fare much better. Mr. Basset gives half a page to proving their existence, and that of forty-five triple tangent-planes, but he has no illustration to give us of even the simplest example of a double-six. Details of the singularities of the twenty-three different types of cubic surfaces are enumerated; but we are not told that, say, the cubic with a nodal line (of the first kind) can be illustrated by the familiar *cylindroid,* models of which are amongst the commonest examples of ruled skew surfaces.

The resolution of compound singularities (chapters iv. and v.) is discussed first for the case of plane curves; the method appears in all cases to rest on the assumption (see, for instance, §165) that the most general singularity of order [1] p can be found on a curve

[1] We have not succeeded in finding a precise definition of what Mr. Basset means by this term: it would seem to be a singular point with p tangents (some or all of which may coincide).

of degree $p+1$. But, even for $p=2$, there is at least one compound singularity not to be found on a cubic curve; this is the cusp of the second kind, the first compound singularity resolved by Cayley. And readers familiar with such investigations as those of Zeuthen ("Math. Annalen," Bd. x.), or Jordan ("Cours d'Analyse," t. i., chapter v.), will recall that it is often necessary to go to terms of quite high order before we can obtain the precise equivalents of any given singularity. It is therefore open to question whether Mr. Basset's cases really include all types of singularity, even for plane curves; and, in the case of surfaces, the method adopted is similar (see, for instance, §§194, 196), so that it is apparently subject to the same kind of objection.

Readers of Mr. Basset's "Treatise on Cubic and Quartic Curves" will recollect his fertility in the invention of new terms, such as *anautotomic, aperigraphic, endodromic,* and so on. We miss the last pair of words in the present book, but *autotomic* and *anautotomic* are to be found on nearly every page, and occasionally new phrases, such as *tritactic, quintactic, nodotangential.* The question as to whether *autotomic* is a suitable term for a surface having a conical point, must be left to experts to settle; but to an ordinary reader like the present reviewer, the word rather suggests a nodal line or curve on the surface. However this may be, the addition of an index, so that the definitions could easily be looked up, would be an advantage to the general reader not specially familiar with Mr. Basset's terminology.

T. J. I'a. B.

AMERICAN MEAT INSPECTION.

American Meat and its Influence upon the Public Health. By Dr. Albert Leffingwell. Pp. xii+208. (London: George Bell and Sons, 1910.) Price 3*s.* 6*d.* net.

DURING the early period of the year 1906 the world was startled by revolting disclosures concerning the stockyards and great packing houses of Chicago, and the conditions which were then described as prevalent were certainly a menace to the public health. Since then the general public in America and England have been under the impression that permanent and satisfactory reforms have been instituted, which have led to the rectification of the abuses then disclosed. But the writer of this work, while conceding that certain improvements have been made, finds a great deal to take exception to with reference to the quality of the meat which is produced both for home consumption and export purposes. He brings forward certain facts which indicate that laws passed in 1906 for the protection of the public health have been so construed and perfunctorily administered that in some most important particulars the Federal inspection of meat leaves much to be desired.

This tendency to favour a lax construction of the law is alleged to be perceptible in many directions. Consider lard, for an example. In the regulations of 1906, which were passed immediately after the outcry in that year, it is stated that no animals dying before slaughter could be brought into any establishment for rendering. It was intended by this regulation to keep suspected carcases away from the tanks where lard is rendered; yet in barely two years' time (April, 1908) another regulation was framed which made this prohibition dependent upon the will of an official. Again, in the 1906 regulations, extracts of meat were included with other meat-food products which were subject to the examinations required by law, yet a subsequent amendment to these regulations exempts these products from meeting the general requirements.

The author produces statistics of the number of post-mortem inspections made of carcases condemned (both in part and in whole) among cattle and hogs for the years 1907 and 1908 respectively; and certainly the statistics of the latter year indicate a marked reduction of the amount of flesh condemned.

We are also informed that the Department of Agriculture has abandoned altogether the microscopic examination of pork for the detection of trichinæ; and the author observes that the American Government now throws the responsibility of contracting this disease solely upon the consumer, if the food should not be thoroughly cooked. Furthermore, a regulation of 1906 required that carcases showing generalised inflammation of the lung, pleura, intestines, peritoneum, or uterus, whether in acute or chronic form, should be condemned; but in 1908 this was amended so as to deal only with *acute* inflammatory conditions.

In a popular work with a mission of this nature one naturally seeks for evidence as to whether the writer is fair, reasonable, and broad-minded—or otherwise. The charges placed before the reader in this work are independent of personal attestation, and they rest entirely upon official documents. The writer, however, expresses somewhat exaggerated views of the necessity for the condemnation of the whole of a carcase in which there is but strictly localised evidence of tuberculosis, malignant disease, &c. In no country in the world is this the practice; and the best scientific opinion would be opposed to the necessity for the enormous waste of good flesh which would result; although one cannot but sympathise with the sentimental objection to eating the flesh of a diseased animal.

It is a well-written and readable book, and its perusal leaves the impression that the meat inspection of the United States is far from satisfactory, and that much of what the writer says in adverse criticism of it is justified. There appears to be no doubt whatever that since the passing of the Pure Food Law, regulations governing meat inspection have been issued which, in a number of instances, considerably reduced the stringency and efficiency of the 1906 regulations.

The writer looks to foreign lands, and chiefly to England, for the remedy. He points out that the English people are vast consumers of American meat and meat products; and he asks whether the meat and meat products packed in tins and exported are likely to be derived from the best of that which passes muster. He hopes and believes that by the practical expression of public sentiment which will result in the lessened demand for such meat, in England and America, the evils will eventually be remedied.

In conclusion, it should be stated that the writer

is one who advocates "an emancipation from the enslavement of the slaughterhouse, with all its evils"; and that he holds the view "that the butchery of animals exists to-day solely because we demand the victims. We have inherited the custom from barbarism; there can be no doubt but that it will be discarded altogether by the higher civilisation of the future race."

THE CHEMICAL ANALYSIS OF IRON AND STEEL.

Die Untersuchungs-Methoden des Eisens und Stahls. By Dr. A. Rüdisüle. Pp. 395+xvi plates. (Bern: Max Dreschel, 1910.) Price 11 marks.

THE title of this book is somewhat misleading. It suggests a survey of the various methods used in the experimental investigation of iron and steel. In reality it is confined to one, viz., the chemical analysis of the constituents.

In his preface the author states that the analysis of iron and steel is one of the most difficult problems in analytical chemistry, and that his object has been to give a critical summary of the methods used in estimating each constituent, with a view to indicating which are the most trustworthy. His book certainly gives a singularly complete account of the details of the methods which have been employed in the last fifty years. But it is only here and there that any attempt is made to compare the limits of accuracy of comparable processes. A technical chemist wishing to estimate, say, phosphorus in a given steel to a certain degree of accuracy, would have considerable difficulty in making his choice from this book. Rapid methods are now the order of the day, and the works chemist has to adopt the quickest, consistent with the necessary degree of accuracy. It is a pity that the author has not borne this in mind more than he appears to have done.

As is only to be expected, by far the greater part of the book deals with the estimation of carbon, manganese, sulphur, phosphorus, and silicon, elements the percentage of which is demanded in all specifications where chemical analysis is included. In view of the detail in which carbon is treated it is surprising to find that no differentiation is attempted between "carbide carbon" and "hardening carbon" in the estimation of "combined carbon," although this is a point of considerable importance. Moreover, there is no reference to the so-called "missing carbon."

The "alloy" steels containing special elements, *e.g.* chromium, tungsten, molybdenum, nickel, vanadium, &c., are well treated, and complete methods are given for various combinations likely to be met in technical practice. There is, however, no mention of uranium, a modern constituent in the armour-plates of more than one navy.

It is significant of the neglect of the influence of gases in iron and steel that the survey of all the methods of estimation occupies only nine in a book of 380 pages. For oxygen only one trustworthy method appears to be known. Nitrogen has fared somewhat better. There is only a scanty reference to carbon monoxide and none to hydrogen and carbon dioxide. Modern metallographical research is insisting on the importance of the effect, particularly of oxygen and nitrogen, on the properties of iron and its alloys. For many years the pernicious influence of phosphorus has been recognised. It is now coming to be admitted that nitrogen may be anything between five and ten times as harmful. As yet no specifications require the estimation of the gaseous constituents in steel. The day is probably not far distant when this will be demanded.

The microscopic investigation of steels has led to another demand, viz., for a knowledge of *how* the various constituents exist in the metal. The present method of returning them as though they existed as such is entirely misleading. In the majority of cases they are combined. Some are segregated as special constituents; others are dissolved in the main bulk of the metal. It is just here that the present methods of chemical analysis are woefully weak; indeed, the researches of Carnot and Goutal stand almost alone as a praiseworthy attempt to obtain information on these matters. If the author, when he comes to prepare a second edition of his book, will include a chapter dealing with the methods that have thrown light on the chemical *constitution* as distinct from the *composition* of steels this will add considerably to the value of an already useful and trustworthy handbook.

H. C. H. CARPENTER.

THE PSYCHOLOGY OF SCIENTIFIC INQUIRY.

Erkenntnistheoretische Grundzüge der Naturwissenschaften und ihre Beziehungen zum Geistesleben der Gegenwart. By Paul Volkmann. Pp. xxiii+454. Second, completely revised, and enlarged edition. (Leipzig and Berlin: B. G. Teubner, 1910.) Price 6 marks.

THE second edition of this work (originally published in 1896) appears as the ninth volume of "Wissenschaft und Hypothese," a series which takes its name from its first number—a translation of Poincaré's well-known essay. The author has adopted, both in the subject-matter and the mode of exposition, numerous changes that are intended to fit the book for its new *rôle*. In particular he has sought, by avoiding unnecessary technicalities and by the multiplication of examples from the history of science, to make his work useful and interesting to the layman. There is no doubt that he has succeeded. The book in its present form, though not comparable in brilliance or charm with the name-volume of the series, gives on the whole a sound and lucid treatment of the matters with which it deals. Its chief weakness is a certain lack of architectural unity and clearness of plan.

The author's general problem is to exhibit the development of science as a psychological rather than a logical process, the result of continued reaction between objective reality and investigating minds. This reaction is conditioned by certain postulates, such as the postulate of congruence between the logical necessities of abstract thought and the phenomena which express physical "law." Also it follows universally the same general course, described by the terms induction and deduction, isolation and super-

position, &c. But the details of the scientific process, and consequently its results, are a function of the mind of the investigator, as well as of the "facts" investigated. Thus there are well-defined types—especially national types—of scientific interpretation, corresponding to typical differences upon the subjective side of the epistemological relation. It follows that an inquiry into the scientific process, to be fruitful, must be based upon a study of its concrete manifestations in history.

This principle is applied in the chapters that make up the greater part of Herr Volkmann's book. The last third is devoted to an analysis of the influence of scientific thought and discovery upon the general intellectual life of our time, as represented in its philosophy, its views on education, &c. A lengthy appendix consists of a reprint of two papers, one a criticism of Newton's methods in the "Principia," the other a critical comparison between the fundamental ideas of Newton's mechanics and the alternative concepts proposed by Hertz.

OUR BOOK SHELF.

Photograms of the Year 1910. *Typical Photographic Pictures Reproduced and Criticised.* Edited by H. S. Ward. Pp. 160. (London: G. Routledge and Sons, Ltd., Dawbarn and Ward, Ltd.; New York: Tennant and Ward, 1910.) Price, paper cover, 2*s*. 6*d*. net.; cloth cover, 3*s*. 6*d*. net.

It is very useful and helpful to the photographer to have under one cover a typical set of the photographs of the year with attendant criticisms of each. It is especially valuable to those who have not had the opportunity of studying the originals for themselves. This annual should therefore be appreciated by a great number of workers, and the one now issued is a worthy follower of the former publications. In the collection here submitted the photographs have been chosen from an enormous number, and the selection, as we are told, has been made by one "who has had exceptional opportunity of considering the world's output for a quarter of a century."

This year the book has been increased by the addition of eight pages of plates, reproduced by the three-colour process from originals by the three-colour carbon method, as well as by the newer single exposure processes on autochrome, Thames, and dioptichrome plates. While the editor points out that these processes and their reproductions are not yet at the "ideal" stage of natural colour photography, they yet afford examples of the expression of artistic individuality. The book, as usual, is of an international character exhibiting photographs by Continental, Colonial, and American workers. It contains forty-eight pages of letterpress and 161 reproductions in monochrome and eleven in colours.

The "Code" School Garden and Nature Note-Book. Edited by G. Lewis. Pp. 96. (London: H. Marshall and Son, n.d.) Price 9*d*.

This little note-book is intended to help the scholar and the teacher in systematising the work and the observations in the school garden. Unless a careful record is kept, the full educational value of many of the observations cannot be obtained, but there may be some difficulty in keeping the records in such a way that they shall be readily accessible. This difficulty is obviated in the present book. The main part of it is divided into twelve parts, one for each month, each consisting of five pages. On the first are a few reminders for the month, showing what should be done in the fruit, flower, and vegetable gardens, what the animals and birds are doing, and what to look for in wild plant-life. The next two pages are for a record of work done in the garden; the fourth is ruled up for meteorological observations, but as only fourteen entries can be made it is clear that daily readings are not contemplated. The last page is for nature observations. At the end of the book are pages for crop records, for temperature and rainfall charts—one for atmospheric pressure might usefully have been added—and for profit and loss account.

The mechanical labour of keeping observations is thus reduced to a minimum, and at the same time the record can always be traced back if necessary. Only those who have attempted to get together class records can realise entirely what a saving of time and trouble this means.

One or two points in the introductory pages want alteration. A loam is not "a soil composed of equal parts of clay and sand." It is not only unnecessary, but undesirable, to give the name "sulpotide" to the definite and well-known sulphide of potassium wash; if the scholar or teacher looked in the index of a standard gardening book he would hardly be likely to see the word mentioned. The author recommends the injection of carbon bisulphide into the soil to kill the larvæ of the click beetle (wireworms); this is hardly a school operation, even if it were effective, and the evidence on this point is by no means clear. But apart from these little points the book is very useful, and can be commended for class purposes.

Handbuch der vergleichenden Physiologie. Edited by Hans Winterstein. Band ii., Erste Hälfte. Neunte Leiferung. Physiologie des Stoffwechsels, Physiologie des Zeugung. Pp. 819–980. Band iii. Zweite Hälfte. Zehnte Lieferung. Physiologie der Energieproduktion. Physiologie der Form. Pp. 161–320. (Jena: Gustav Fischer, 1910.) Price per fasciculus 5 marks.

When the earlier fasciculi of this ambitious work appeared, we noted the general characters and aims of the undertaking. The ninth fasciculus contains a continuation of Prof. W. Biedermann's article on nutrition in the different classes of the world ot life; but the article in question is not yet concluded. Each group is considered in detail, and the outcome will be a most valuable work of reference, and contains a mine, not only of information, but of references to original researches. The bibliographical notices relating to digestion and nutrition in the insects and myriapods alone number 247.

The tenth fasciculus is a portion of the third volume, which deals with quite different subjects. No doubt it is a convenience to the editor to print the bits as they are ready, though it is a little confusing to the reader. It contains portions of two articles; the first is the conclusion of an article on the production of electricity in animals and plants, by Prof. S. Garten, and the second the commencement of an article by Prof. Ernst Mangold, on the production of light in living things, especially in animals. The two articles manifest the same thoroughness of treatment noticeable in the previous fasciculi, and we congratulate the editor on having secured the service of collaborators who are all actuated by the same high ideals.

Guide to the British Vertebrates Exhibited in the Department of Zoology, British Museum (Natural History). Pp. vii+122, with a plan and 26 illustrations. (London: Printed by order of the Trustees of the British Museum, 1910.) Price 1*s*.

This guide contains a concise account of the British vertebrates other than the turtles and marine fishes,

which are altogether omitted, and the Cetacea, of which only a list is given. The seventy-five species of mammals are dealt with in an interesting manner, references being made to their habitat, food, care of young, change of coat, hibernation, &c. The common and Latin name of each species is given, and we are glad to note that where the Latin name has recently been changed the older and more familiar designation has also been added. The large number (442) of birds in the British list necessarily means that each can receive only comparatively short notice in the space available; nevertheless, a large amount of interesting information is packed into the twenty pages devoted to this part of the subject. The reptiles—three snakes, the blind-worm, and two lizards—and the Amphibia, seven in number, are described, with notes on their distribution and habits. The account of the fishes, which is restricted to those occurring in fresh water, also contains many interesting observations on their distribution, the distinctions between allied species, spawning, &c.

An appendix contains a full list of the species of vertebrates, other than turtles and marine fishes, which have been recorded from the British area. In the case of those birds which have occurred not more than six times notes are added or references given to the records of capture. The illustrations, about half of which are reproduced from photographs, are good, and several are of special excellence. The volume forms a thoroughly serviceable guide to the collection.

The Sea-Kings of Crete. By the Rev. James Baikie. Pp. xiv+274. (London: A. and C. Black, 1910.) Price 7*s.* 6*d.* net.

As a compilation this work shows great diligence; it has evidently been written *con amore,* and its aim is most praiseworthy; but it has no scientific value. We prefer to see *œuvres de vulgarisation* of this kind written, when possible, by the excavators themselves. This is no doubt a counsel of perfection; they have usually too much to do to write popular books. But in any case, such books should only be written by trained archæologists with a first-hand knowledge of the subject and a personal acquaintance with Crete itself. Of these qualifications we do not see much evidence in Mr. Baikie's work, which, after the publication of the books of Mrs. Hawes (a Cretan excavator) and Prof. Burrows, seems scarcely needed.

Pinro. (Brook's patent.) (W. J. Brooks and Co., Letchworth, Herts.) Price 1*s.* per twelve yards.

THIS device consists of a thin metal tape, from which fine steel points project at intervals of about four inches. It is intended to be used by draughtsmen as a substitute for drawing-pins, and also for attaching canvas, posters, fabrics, &c., continuously along the edges. The contrivance does not seem to us likely to be generally adopted, but there are special circumstances under which it might be found very serviceable.

Teachers' Notes on Nature-Study: Plants and Animals. Pp. viii+232. (London: Blackie and Son, Ltd., n.d.) Price 1*s.* 6*d.* net.

THIS re-issue of an old work will not commend itself to teachers who desire to make the school study of science a training in accurate observation, simple reasoning, and precise expression. The method of teaching, the haphazard arrangement of subjects, and the general absence of scientific treatment, all remind the reader of the discredited style of "object-lesson" common ten or fifteen years ago. The compiler, whose name is withheld, does not appear to realise the necessity in the case of young pupils for basing every lesson on plants upon specimens in the hands of each child, and encouraging the children to draw from the specimen rather than from the teacher's blackboard sketches.

The Scientists' Reference Book and Pocket Diary for 1911. (Manchester: J. Woolley, Sons and Co., Ltd.) Price 1*s.* 6*d.*; bound in morocco, 2*s.* 6*d.*

IN addition to a handy diary in which provision is made also for memoranda and addresses, this publication provides a very useful book of tables and facts likely to be of use to workers in science, as well as to students. In view of its small price the combination is likely to secure a wide popularity.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Historical Note on Recalescence.

THE interesting *résumé* of Prof. Arnold's British Association paper on recalescence, which appeared in NATURE for December 1, contains the following statement in the opening paragraph:—

"In 1868 the late Dr. Geo. Gore, F.R.S., discovered the recalescent points now known as Ar_3 and Ar_2, and in 1872 Prof. W. F. Barrett, F.R.S., discovered the recalescent point Ar_1, which is now known as the carbon change point. Prof. Barrett gave the phenomena the generic title of 'recalescence,' by which they have been known ever since."

As no little misapprehension exists on this subject, it is desirable, as a matter of historical accuracy, to state that Dr. Gore did not discover the phenomenon of *recalescence,* but he was the first to observe the remarkable momentary elongation of an iron wire during cooling from bright incandescence, which important observation subsequently led to the discovery of recalescence.

Owing to the great practical importance which recalescence has assumed in the hardening and heat treatment of steel, it may perhaps be of interest if I briefly state the early history of this discovery.

The Proceedings of the Royal Society for January 28, 1869, contains a paper by Dr. Gore which records the anomalous behaviour of cooling iron above referred to—its sudden transient expansion at a dull red heat. This anomalous behaviour Dr. Gore found was not shared by other metals, and he states that no reverse effect was noticed upon heating iron wire to incandescence.[1]

Some two years later, having to deliver a lecture before the Royal Dublin Society on the "Molecular Changes that accompany the Act of Magnetisation," I was anxious to show Mr. Gore's interesting discovery, as it appeared likely to be connected with the resumption of the magnetic state in iron when cooling from a white heat. In answer to my inquiry Mr. Gore kindly furnished me with his apparatus, and as he said he had no further use for it I purchased it from him, and it is still in my possession. To make the effect visible to a large audience a mirror was attached to the spindle which moved the index, and from it a ray of light was reflected to a distant scale. This device revealed the fact, overlooked by Dr. Gore, that a small momentary *contraction* of the iron wire took place during its heating to incandescence, approximately at the same temperature at which the momentary elongation occurred in cooling.[2]

Dr. Gore having informed me, in a letter dated May, 1872, that he was not pursuing his original observation and that the subject was quite open to anyone, I felt at liberty to continue the inquiry. Accordingly, the following year, Dr. Guthrie having kindly placed his laboratory

[1] In fact some eighteen months after his original observation Dr. Gore states in a paper published in the *Phil. Mag.* for September, 1870 (the italics are his):—"The iron during cooling . . . suddenly elongated by diminution of cohesion . . . a corresponding but reverse phenomenon did *not* occur during the process of *heating* the wire."

[2] This lecture was repeated at the London Institution a year later, and a full report of it is published in the Journal of that Institution.

at South Kensington at my disposal, an investigation was begun, which led to the discovery of recalescence on September 12, 1873. On that date I noticed that accompanying the Gore effect in cooling iron, and at the same critical temperature, a sudden reheating or *after glow* occurred. It was more difficult to detect the reverse effect on heating, but a momentary arrest of the heating appeared to occur at the critical temperature. The Chatelier thermo-electric pyrometer was unknown at that time, and I had to have recourse to an air thermometer, which showed that the after glow was not an optical illusion, but a real, though transient, accession of temperature, due to a liberation of latent heat and not to surface oxidation of the iron, as was shown by the recalescence occurring as strongly in an atmosphere of nitrogen or other inert gas as in air. Furthermore, this effect appeared to synchronise with the critical temperature at which iron lost on heating and regained on cooling its magnetic power, and with the remarkable thermo-electric inversion in iron which Prof. Tait had then recently discovered. I noticed, also, that a crepitation occurred in the iron at this temperature resembling the Page effect on magnetising iron.

These and other observations were described, and the experiments exhibited at the British Association meeting at Bradford a few weeks later, September, 1873, and the paper was published in the *Philosophical Magazine* for December, 1873.[1] An interesting discussion on recalescence followed the reading of my paper, in which Prof. Clerk Maxwell, Mr. Herbert Spencer, Prof. Carey Foster, and others took part. This was reported in the local papers at the time, and happily is preserved in a number of the now defunct *Quarterly Journal of Science*.[2]

Later on a British Association Committee was appointed to report on the whole subject, Prof. Geo. Fitzgerald being chairman and myself secretary. Unfortunately, a long delay occurred in the publication of the report, partly owing to my removal to Dublin and the pressure of work in the chair to which I was appointed; meanwhile, the subject was greatly enriched by the researches of others, especially by M. Osmond, who in 1886 made it the starting point of his classical investigations. An interim report by the British Association Committee was, it is true, published, but I would specially refer to the final lengthy report published in the Proceedings of the British Association for 1890, which had the advantage of Prof. Geo. Fitzgerald's cooperation, he having witnessed and corroborated some of the earlier experiments described therein. It is there shown that in 1875 two recalescent points were found, most markedly in steel wire, "the second and far stronger after glow being exactly coincident with the sudden elongation of steel wire during cooling" (the Gore effect). As that report is easily accessible, I will not refer to the other observations it contains. Amid the large literature on this subject which has grown up attention should be directed to an excellent investigation by a Swede, Dr. G. E. Svedalius, on the "Measurement of the Anomalous Changes in the Length and Temperature of Iron and Steel during Recalescence"; this was communicated by Prof. Geo. Fitzgerald to the *Philosophical Magazine* for August, 1898.

With regard to the allotropic form of iron which appears to be produced at high temperatures—Osmund's β iron—and the liberation of the latent heat of allotropy during cooling causing recalescence, I may point out that Prof. Tait, from his thermoelectric researches, had been led to the conclusion, as stated in his Rede lecture in 1873. "that iron becomes a different metal on being raised above a red heat." But I believe Prof. Geo. Forbes was the first to suggest and publish the fact that recalescence might be due to the liberation of the latent heat of an allotropic form of iron. Writing to me upon my experiments on April 18, 1874, he remarks:—"It would follow that iron heated to an intense white heat assumes an allotropic form, and that at this temperature [of recalescence] when cooling it changes to the other form and gives off latent heat."

In conclusion, let me congratulate Prof. Arnold upon his investigations, extending over so many years, and the light he has thrown on the causes of the different phases of recalescence and the importance of the carbon change point. No doubt he is aware that M. Svedelius, in the paper referred to above, also experimented with electrolytic iron. Referring to the expansion at the critical temperature, Svedelius says:—"In a rod of electrolytic iron the magnitude of the expansion at D_1 decreased very rapidly with every renewed heating, and after the fiftieth heating no trace either of the critical point D or D_1 could be discovered"; and he adds in a footnote:—"This confirms the statement made long ago by Prof. Barrett that in very pure iron the anomalous contraction and expansion could be 'washed out,' as it were, by repeated heating and cooling." I do not know whether Prof. Arnold has experimented with a very low carbon "burnt iron" to ascertain whether any recalescent points remain in such iron.

W. F. BARRETT.

Kingstown, co. Dublin, December.

[1] "On Certain remarkable Molecular Changes occurring in Iron Wire at a Low Red Heat. *Phil. Mag.*, December, 1873, p. 472; see also my paper in the following number of the *Phil. Mag.*

[2] Upon the publication of my paper in the *Phil. Mag.*, Dr Gore wrote to me as follows, in a letter dated Edgbaston, December 22, 1873:—"Your new discoveries respecting the molecular changes in iron, described in the *Phil. Mag.* for this month, have greatly pleased me; especially the sudden development of heat attending the elongation during cooling, and the sudden shortening during heating." Furthermore, when Sir Roberts-Austen in a lecture before the British Association in 1889 made much the same error as that quoted at the beginning of this note, Dr. Gore at once wrote to me and expressed his great surprise that the discovery of recalescence should be attributed to him.

Captain Cook Memorial.

UNDER the auspices of the British Empire League, a very representative and influential committee has been formed to carry out the proposal made by Sir Joseph Carruthers, K.C.M.G., ex-Premier of New South Wales, that a monument should be erected in London to the memory of Captain Cook; but I venture to ask. is this the best way to honour the memory of the illustrious navigator? Captain Cook was a great seaman, geographer, and ethnologist; indeed, he was one of the foremost of the men of science of his day. As his life was devoted to discovery of various kinds, surely the best memorial to him would be to establish a fund, associated with his name, the interest of which should be devoted to the prosecution of investigations analogous to those in which he spent his life and met his death.

Cambridge, December 13.

A. C. HADDON.

Accuracy of Time on Magnetograms.

I AM greatly interested by Dr. Krogness's letter in NATURE of December 8 directing attention to this matter. We have been investigating this point for some time by interrupting both trace and base line in our Adie magnetographs.

We find that, in general, if the times are taken from the base line we should actually get declination for about two minutes later, but horizontal force and vertical force for two minutes earlier. The error is probably not constant, and so we have decided to interrupt the trace. It may be of interest to say that we have been able to reduce the interruption to one minute, which corresponds to $\frac{1}{4}$ mm. on the paper.

GEORGE W. WALKER.

The Observatory, Eskdalemuir, Langholm, Dumfriesshire, December 19.

The Quadrantid Meteor Shower.

IF the maximum of this meteor shower should occur when the earth is in the same position with regard to the sun as was formerly the case, it would take place in the daytime of January 3, 1911, but this shower does not seem to have been sufficiently watched of late years to ascertain when the maximum now occurs. There is, however, some reason to believe that it will not be until the evening of January 3, in which case, as there is no moonlight, it would be a very favourable opportunity for its observation in this country. As the maximum is of short duration it ought to be more extensively watched for annually than appears usually to be the case.

T. W. BACKHOUSE.

West Hendon House, Sunderland, December 13.

ORIENTAL OR BUBONIC PLAGUE.

PLAGUE is an acute infective disease, an infectious fever, attacking man and some of the lower animals, and attended with a considerable mortality. The symptoms in man develop within a few days of infection, and consist of fever, headache, giddiness, weakness, with staggering gait, great prostration, and delirium. In 75 per cent. of the cases the lymphatic glands in the groin, armpit, and other regions are inflamed, infiltrated, and much enlarged, constituting the "buboes," hence the name "bubonic plague" frequently given to the disease.[1] In the remaining cases, the lungs may be primarily attacked, the "pneumonic" form, or a severe blood infection may develop, the "septicæmic" variety; in both of these buboes are absent, or are a late development if the patient lives. Occasionally an eruption of pustules or carbuncles appears on the skin, a phenomenon frequently mentioned by the older writers, and abscesses may form in the buboes. The bubonic form is hardly infectious or even contagious, but the pneumonic variety is highly infectious, owing to the presence of large numbers of the infective agent, the plague bacillus, in the expectoration from which it is readily disseminated in the air. In some instances the patients do not appear particularly ill, and are able to go about, though such cases are liable to sudden death from heart failure.

The micro-organism of plague was discovered independently by Kitasato and by Yersin in 1894. It is a stumpy, rod-shaped organism or "bacillus," having rounded ends, and measuring as a rule about 1/8000 inch in length, and 1/16000 inch in breadth, but longer forms occur. In smears made at an early stage of the disease from the buboes, expectoration or blood respectively in the three varieties, the bacillus is present in enormous numbers, and if the films are stained with an aniline dye, such as fuchsia, it tends to stain deeply at the ends ("polar staining"), the centre being hardly stained at all (see Figs. 1 and 2); this is a very characteristic appearance. In older lesions peculiar, large, rounded or ovoid "involution" forms of the bacillus are met with. The organism can be readily cultivated in various media in the laboratory; it is non-motile, and does not spore, and is readily destroyed by heat (60° to 65° C. for ten to fifteen minutes), and by disinfectants. The plague bacillus is pathogenic for a number of animals, in addition to man—the rat, mouse, guinea-pig, rabbit, hare, ferret, cat, monkey, &c. In the United States the ground squirrels are attacked.

A remarkable feature which has characterised plague from the earliest times is the alternation of periods of widespread prevalence, "pandemics," with periods of quiescence and complete intermission. Thus, in the fourteenth century, in the course of three years, plague decimated the whole of Europe, with an estimated destruction of one-fourth of the population, appearing in England as the black death.[2] In the fifteenth, sixteenth, and seventeenth centuries there were frequent outbreaks in Europe, Asia, and Africa, more or less limited in extent, culminating in England in the great plague of London, with 97,306 burials in 1665, of which 68,596 were attributed to plague, whereas in the five years preceding and succeeding this terrible visitation the normal number of burials in London ranged from about 15,000 to 20,000. Plague then rapidly disappeared from western Europe, so that by the end of the seventeenth century it was practically extinct, and save for isolated outbreaks (*e.g.* at Marseilles and Toulon in 1720) occurred only in Turkey, the Levant, Egypt, and Asia Minor. Thus plague was practically unknown to the present generation until 1894, when it reappeared in epidemic form, this time in Hong Kong. There have always been localities in which plague has been "endemic," *i.e.* continuously prevalent, for example, on the Persian Gulf, in Asia Minor, and in Yunnan, a province of China bordering on Burmah and Tibet. According to Prof. Simpson, plague travelled from Yunnan by the overland trade routes to Canton, thence by river to Hong Kong; from Hong Kong the disease was sea-

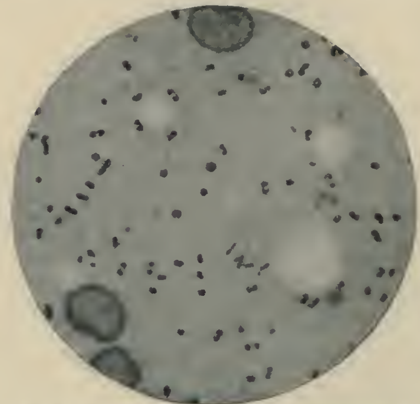


FIG. 1.—Smear from bubo showing large numbers of plague bacilli. ×1200.

borne to India, where it certainly appeared in 1896, and since then has similarly been carried all over the world. The agent by which the disease has been so widely disseminated is the rat, infection from man to man being almost negligible, the rat fleas being the intermediaries between the rat and man, and mechanically conveying the infection—the plague bacilli—from rat to rat, and from rat to man (*vide* an article by Dr. Petrie in NATURE, November 3, p. 15). For combating the spread of plague, the destruction

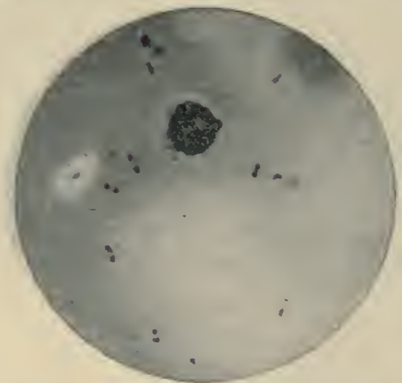


FIG. 2.—Smear from spleen of infected Ferret (from Suffolk), showing typical bi-polar staining plague bacilli. ×1200.

of rats is therefore an important measure. While it seems hopeless to effect complete destruction of these rodents, a great deal can be done to lessen their numbers, and the survivors will probably be less likely to be infected. The destruction of rats may be carried out by systematic trapping, ferreting, and poisoning, but anyone who has had to deal with rats is aware how "cute" they are, and the most tempting morsels will often fail to attract them to trap or poison. Handling the material or trap is sufficient to rouse their suspicion, and the "taint" of man, if present, must be destroyed by flaming or disguised by the use of

[1] Although this is the rule, Prof. Simpson points out that in Accra, West Africa, 50 per cent. of the cases were of the pneumonic variety.
[2] I am indebted to Prof. Simpson's "Treatise on Plague" for these and other historical details.

some strong-smelling substance, such as aniseed. Moreover, after a few rats have been caught or poisoned in a locality, the survivors will frequently migrate elsewhere, hence the need for concerted and systematic action in and around a district in which plague has occurred.

Although plague cases may occur at any time of the year, the disease usually exhibits a marked seasonal prevalence. In Poona plague is epidemic only from July to February, August, September, and October being the months of maximum prevalence. This period corresponds closely with the extent of flea prevalence on the rats. An epidemic terminates naturally, owing to a combination of adverse factors, *e.g.* decrease in the number of fleas, decrease in the number of rats, and an increase in the proportion of immune to susceptible rats.[1] In some instances plague cases may be completely absent between the seasons of prevalence, but by what means the infection is kept alive in the intervals has not yet been determined. Rats are occasionally met with suffering from what has been regarded as chronic plague, but the latest investigations of the Indian Plague Committee indicate that the condition is one of recovery from plague infection, and the condition is stated to possess no significance in the seasonal recurrence of the disease among the rats.[2]

The recent outbreak of plague in Suffolk, though in itself insignificant, is disquieting owing to the fact that plague-infected animals—rats, rabbits, hares, a ferret (see Fig. 2), and a cat—have been met with in five districts in Suffolk, in one district in Essex, and in the London Docks, indicating a somewhat wide distribution of infected localities. This may be of no moment, but, on the other hand, it may in the future lead to scattered outbreaks of human plague, probably not in themselves very serious, but possibly causing great injury to commerce. Thus, if, say, half a dozen cases of plague occurred in the neighbourhood of the docks, the Port of London would be placed in quarantine,[1] and the home and foreign trade of the port amounts nearly to *one million pounds per day!* It behoves the authorities therefore to prosecute a vigorous, concerted, and systematic campaign against the rats with a view to the detection and the limitation of infected areas; now is the time for action, for when infection becomes widespread it is too late.

For the photo-micrographs I am indebted to Mr. J. E. Barnard. R. T. HEWLETT.

[1] See "Reports on Plague Investigation in India," Nos. xxxvi and xxxvii, *Journal of Hygiene*, x. No. 3.
[2] *Ibid.*, Report No. xxxiv.

[1] Plague and cholera are the two diseases now quarantinable under the Paris Convention.

EXPLORATION IN THE NEARER EAST.

IN his latest book,[2] Mr. Hogarth has given us a series of brilliant sketches, each of which centres round some episode in a life of very varied archæological adventure. It is a delightful form of autobiography, for we find no dull pages to skip, no laboured accounts of worthy but uninteresting achievement. Each chapter is a separate picture in itself, and, as we read, we find ourselves transported, with somewhat startling rapidity, throughout the lands of the Nearer East. We see the author at work as an archæologist on the coasts of Asia Minor, in Crete, among the Nile fens of the Delta, in Upper Egypt, on the North African coast at Cyrene, and by the banks of the Euphrates and Sajur, to say nothing of the time when he served as the *Times* correspondent in Thessaly during the Græco-Turkish war. Few archæologists, if any, have accomplished work of so

FIG. 1.—Rigging the great Pump at Ephesus. From "Accidents of an Antiquary's Life."

[2] "Accidents of an Antiquary's Life." By D. G. Hogarth. Pp. x+176. (London: Macmillan and Co., Ltd., 1910.) Price 7s. 6d. net.

varied a character, and certainly none has Mr. Hogarth's gift of vivid narrative. Many readers will doubtless be surprised that the study of archæology should prove so attractive and picturesque an occupation, but it is not without its hardships, as Mr. Hogarth's pages bear witness. Saddle-sores, poor food, the necessity to keep going even when half-dead with malaria, and the absence of skilled advice when suffering from other ailments, have to be faced by anyone who would take part in the exploration of the less accessible countries of the Nearer East. But Mr. Hogarth lays no undue stress on what he has undergone, and in his introductory chapter, which he entitles an "Apology of an Apprentice," he examines the basis of the faith that has sustained him.

FIG. 2.—Half Buried Palm-forest, Baltim. From "Accidents of an Antiquary's Life."

We do not pretend to an opinion as to whether an antiquary, like a poet, is born, not made, but there can be little doubt that careful training may do much to mould an original, though perhaps latent, inclination. Apart from the fact that he is more curious of the past than the present, Mr. Hogarth well describes the antiquary as loving detail for its own sake and as caring less for ends than means. His ideals are, in fact, rather different from those of the purely scientific mind. The severe man of science may extol the pursuit of knowledge for its own sake, but at the back of his mind there is always an idea of benefiting somebody or something. The true antiquary has no such obsession. The results of his labours, when set out and labelled in public museums, may perhaps have an educational value—archæology may after all be the handmaid of history—but to him the pursuit is an end in itself apart from its results.

FIG. 3.—The Theatre of Aspendus. From "Accidents of an Antiquary's Life."

Though such may be the philosophy of "the antiquarian trade," Mr. Hogarth does not fail to recognise that plunder is a real incentive, even to the most

philosophical of inquirers; and the material results of his own explorations give them a satisfying completeness, like the buried gold which should always reward the treasure-seeking hero of romance. One of the most exciting episodes in the volume, the exploration of the limestone cave on Dicte, the legendary birthplace of Zeus, affords an instance in point, and shows how unexpected may be the treasure that sometimes awaits the fortunate explorer. Having blasted a way into the cave through the fallen rock and boulders that blocked its entrance, a fortnight's careful search of the soil in the upper cave was rewarded by a certain number of votive offerings around an altar of burnt sacrifice. But it was at the end of the excavation, when it only remained to search the lower cave for objects that might have slipped down during the secret digging of the past few years, that the element of luck came in. The floor of the lower cave is covered with an icy pool which runs far into the hill about the bases of fantastic stalactite columns. Here, Mr. Hogarth tells us, he did not expect to find much spoil, since no native had ever found anything in the pool among the columns, except a few scraps of water-borne pottery from above. But with the true archæologist's instinct of seeing for himself, Mr. Hogarth ordered a thorough search. Not much was found in the pool itself, but a zealous worker, wanting to put both hands to his work, happened to wedge his candle-end in the fluting of one of the stalactite columns, and by its light he perceived the green edge of a bronze blade in the slit. A further search was at once ordered:—

"Men and girls dispersed themselves along the dark aisles, and perching above the black waters on natural crockets of the pillars, peered into the flutings. They found at once—found blades, pins, tweezers, brooches, and here and there a votive axe, and in some niches as many as ten votive things together. Most were picked out easily enough by the slim fingers of the girls; but to possess ourselves of others, which the lights revealed, it was necessary to smash stalactite lips that had almost closed in long ages."

These were all votive objects, placed on the columns of that silent pool that formed the shrine of the god of Dicte. "As we saw those pillared aisles," Mr. Hogarth remarks, "so with little change had the last worshipper who offered a token to Zeus seen them three thousand years ago."

Another venture that was crowned with unexpected spoil was the excavation of the great Artemisium at Ephesus, when the resources of modern engineering had to be invoked to pump out the flooded excavation around the base of the "Great Altar" and the foundation-deposit. The illustrations to the volume, unlike those in so many modern works, really illustrate the text, and each fits naturally into the narrative. Of those we have chosen for reproduction, one shows the rigging of the great pump at Ephesus; another, representing a half-buried palm-forest at Baltim, well illustrates the constant eastward progression of the shifting sand-dunes which fringe the great flats of the Nile delta; the other, taken in the theatre of Aspendus in Pamphylia, forms a striking contrast to the Ephesus photograph, and shows the remarkable state of completeness in which a building of classical antiquity may be preserved. Of all Roman theatres this is perhaps the most perfectly preserved example.

The book contains several good stories, such as that of the young British subaltern who knew no word of Greek, but arrived on a polo pony "to be a father to some twenty Cretan villages," and whose judgments, delivered in knickerbockers and a cricket shirt, were worthy, in their practical aspects, of a Solomon. But we have already trangressed the space allotted to us, and in any case we would not quote or summarise the many passages we have marked. We prefer to leave them unspoiled for the reader, to whom, whether he be of an archæological bent or not, we warmly recommend the volume as excellent reading.

L. W. K.

ANTI-MALARIAL MEASURES IN INDIA.

A PERMANENT committee dealing with anti-malarial measures in India has been appointed by the Government of India. Its members are Lieut.-Col. Leslie (Sanitary Commissioner with the Government of India), Major James, I.M.S., Captain Christophers, I.M.S., and Lieut.-Col. Semple. Excluding the last-named, whose views on the matter have not yet been made public, the members of the committee, previous to their embodiment, allowed it to be understood that, in the light of the reputed failure of the Mean Mir "mosquito reduction" experiments of 1901–3, they hold any effort beyond quinine prophylaxis as rarely applicable to India. Indeed, they claim that conditions in that country are so different from those found in other parts of the world that further investigations—and not application of elsewhere approved anti-malarial measures—is the necessary *rôle*.

An earnest of this attitude is exhibited in the publication by it, under the auspices of the Government of India, of a brochure entitled "Paludism," which it is announced will appear at irregular intervals—as results from its labours become available. The editor (Major James) in describing the functions of the committee and its relation to Sanitary Departments and local bodies under provincial Governments, states that the conference on anti-malarial measures in India, held at Simla in 1909, "strongly supported the establishment of this organisation." The terms used by the editor, however, seem unduly optimistic. A reference to the Proceedings of that conference shows that the appointment of this committee was not open to option, but was definitely announced as an accomplished fact by the Government of India; and that there are recorded marked objections by members, not to the existence of the committee as a scientific body, but to its possessing the extraordinary administrative power to "direct (*sic*) and coordinate investigations" throughout India, which, in the presence of Indian official methods and the huge area involved, cannot fail not only to trammel the initiative of local Governments and their Sanitary Commissioners, but must hopelessly delay the execution of practical measures.

Although, doubtless, having regard to the excellent *personnel* of the committee, the publication will from time to time furnish scientific matter of value, in the absence of insistence by the Government of India that practical anti-malarial measures be undertaken, public opinion will be apt to hold that its primary function is that of a convenient financial scapegoat. The first number of *Paludism,* after referring to the functions of the committee, affords an original paper by Captain Christophers on the use of statistics in investigating the epidemiology of malaria, and gives abstracts of papers relative to paludism *in countries other than India.*

In the meantime, sanitarians with no lack of local experience have failed to see that there is in the environment of the mosquito in India more startling conditions than have been met with and overcome elsewhere. Major Ross, C.B., especially, has from time to time called in question the correctness of the Mean Mir experiments; and, in person, he challenged the methods and conclusions of the officers concerned

at the Indian Medical Congress held at Bombay in 1908. It was therefore a wise decision on the part of the Government of India, on the termination of the Simla anti-malarial Conference of 1909, to depute a special committee of inquiry on this subject. The officers selected were the Hon. Mr. Nathan, I.C.S., Colonel Thornhill, I.A., and Major Leonard Rogers, I.M.S. Whilst all its deductions cannot be accepted, this committee has produced a report which, though omitting important details, is a remarkable product of a single month's work. The experimenting officers, Major James and Captain Christophers, apparently elected to test statements made by Major Ross, and regarded Mean Mir as a suitable locality for this object. Of several typical extracts from his publication and speeches quoted in the report as justifying their methods, the following is selected as of the most definite nature:—

"It is now a matter of the general experience of many investigators that where mosquitoes abound in a house their larvæ can easily be found at a short distance, say within a few hundred yards of the house. Occasionally, where the house is isolated and no stagnant water is in its immediate vicinity, mosquitoes may attack it from a greater distance; but this is exceptional, and in the great majority of cases, especially in towns, almost every house breeds its own mosquitoes in its backyards or in puddles or drains in the streets close by."

To meet the necessities of a test experiment guided by such very general data, it would have been well, whilst relying upon the importance of the observation as to pools in the vicinity of houses, also to have ascertained from the authority concerned what he implied by a "few hundred yards" of the house and even "a greater distance"; especially as by making pools unfit for the reception of larvæ by "oiling" in the neighbourhood of houses, there was fulfilled—so far as the mosquito is concerned—the condition that "no stagnant water" be available in that position.

The area selected by Major James was an oblong—and not an isolated—portion of two square miles of the total of eight square miles of the cantonment of Mean Mir, whilst the line defining its limit, except on the west, was "drawn close round the residential quarters, no attempt being made to deal with the outlying uninhabited areas." The map furnished with the report proves that the distance of dwellings from untreated portions of the cantonment varied from 40 to 260 yards, and that the limiting line abruptly excluded numerous pits and rain-fed depressions. It is a curious commentary upon this haphazard method of conducting an important experiment that Dr. Balfour, in his successful work at Khartoum, did not similarly interpret Ross's dicta with which he professed agreement.[1]

More reasonable measures were, however, employed by Captain Christophers when operations fell under his charge. He found that the flight of the mosquito could be estimated at 1320 yards, and, thereupon, he reports, he extended the area maintained by Major James three-quarters of a mile "in every direction."[2] Unfortunately, however, action was not taken by him on this basis until the end of August, 1903, which, having regard to the duration of life of the mosquito, was perilously close to the ensuing three months known locally as the "fever season." Moreover, on comparing the map accompanying his own report with that furnished by the committee, it will be seen that confusion exists as to the essential point of measurement being made from the most external of the houses of groups of dwellings protected, and not, for example, "from the centre of the inhabited area"—a method which seems to have been erroneously adhered to by the reporting committee. Comparative measurements show that, in reality, he extended Major James's area 220 yards in the north, 465 yards on the west, 500 yards in the east, and a little more than three-quarters of a mile on the south. Yet, had the same solicitude been afforded in other directions as to the south, so as to secure a uniform extension of three-quarters of a mile "in every direction," there would have been included the native cavalry lines, the west infantry lines, the east native infantry lines, the lowlying dhobies' ground, and part of the pits of the east rifle range.

The map showing present conditions, and the accompanying description by the committee of work done in the filling of pits, subsequent to abandonment of the experiments by Captain Christophers, prove that under this arrangement there must have remained untreated very numerous and favourable spots for larvæ. The committee, in summing up its evidence, has recorded its opinion that mosquito reduction, under conditions prevailing in Lahore, was impossible; but it seems to us clear that the experiments were based upon an erroneous interpretation of data said to have been adooted for guidance, and, in execution, so lacking uniformity of method as to be of no sanitary value.

On completion of the "mosquito reduction" experiments at Mean Mir, the Government of India left the cantonment to its fate until Surgeon-General Hamilton, C.B., urged the employment not only of "mosquito reduction" methods, but the systematic improvement of surface drainage, the abolition of canals, and irrigation within a definite (but we think insufficient) radius of dwellings, and the employment of quinine prophylaxis. This highly practical advice met with warm support from General Kitchener, who was in charge of the division, and operations were accordingly carried on from 1904 to 1909. Nevertheless, those who would support a *laissez-faire* policy in India have declared that these efforts have also proved inapplicable. But, it is evident from the committee's report that in no detail has the advice of Surgeon-General Hamilton, up to date, been acted upon in so complete a manner or with such a grade of efficiency as would warrant final conclusions as to possible benefits.

In its conclusion, the committee holds that the "general prosecution" of major schemes, such as conducted in Panama, Lagos, and Sweetenham, is financially impracticable; it regards anti-larval measures combined with quinine prophylaxis as offering "great possibilities," and advises action by Government on this system, but would defer this pending investigations by the committee referred to above, in our notice of *Paludism*. For the rest, it would trust to education of the people, which they state "thus lies at the root of the problem." There is here therefore a diminution of hope as to practical measures by a process of whittling, and a suggestion of the Greek Kalends as to consummation. In using the term "general prosecution" of schemes, the committee has presumably laboured under the common misapprehension that sanitarians would desire the sudden expenditure of crores of rupees on anti-malarial "major works" throughout India. What, however, is pleaded for is that the Government of India should no longer be guided by results of experiments conducted at Mean Mir by haphazard methods, and thus fail, as it has for several years—apparently in

[1] Second Report Wellcome Research Laboratories (Khartoum), p. 21.
[2] Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India, No. 9, p. 8.

consequence of advice founded on such results—to insist that local governments and local bodies serving under it shall no longer fail to class anti-malarial measures as practicable, but shall estimate for and finance them when feasible.

As to the combined anti-larval measures and quinine prophylaxis, of the "great possibilities" of which the committee is hopeful, obviously they could be conducted continuously, at the least feasible cost, by the Government of India insisting that a correctly organised and well-educated executive sanitary service should be available in each province, as, if the still incomplete service in the Madras Presidency be excepted, not even the skeleton of such an organisation yet exists in India.

As for "education," the only form that will appeal to the average Indian villager for the next century is practical demonstration of what correctly conceived anti-malarial works can accomplish. His acquiescence in Western *theories* would be but a polite fiction, although no race can more quickly, or more gratefully, appreciate sanitary works demonstrably decreasing sickness and death; nor, in the face of his conviction as to their utility after their completion, would he grudge his contribution towards them.

Municipalities do at the present time undertake large sanitary works (other than anti-malarial) at a cost from Rs.4 to Rs.12 per head of the population served. But it is apparently the typical "small town" under district board jurisdiction that presents to the committee the insuperable difficulty of financing "major schemes." But in this is involved an erroneous method of regarding the matter. In severe cases of malaria justifying major schemes, when a town is impoverished by sickness and mortality, and, moreover—as such places must be—is a danger to the surrounding inhabited areas of the district in which it is situated, by reason of its wandering human malaria germ-bearers, it is sound political economy to require not solely the already impoverished locality but the district board, and, in exaggerated cases, the provincial government concerned, to afford financial aid, in part or whole. Nor need such a distribution of responsibility be regarded as financially impracticable if these principles be recognised. The borrowing powers of district boards remain practically unexploited, whilst the expenditure of funds in their charge is so erratic, and in such ill-considered proportions to the various requirements of the Acts they administer, that the best value is not obtained.

Average taxation for district board purposes does not exceed three half-pence per head *per annum*; but a single attack of fever (against several possible) *per annum* in the case of an adult, if the standard treatment by quinine approved by the Simla Conference be resorted to, would cause an unproductive expenditure of 10*d*. for this single drug, besides that due to extra luxuries during sickness, adjuvant medicines, and ceremonies, &c., irrespective of loss of labour. Yet, in the Punjab, where, during 1908, in round figures, there occurred 700,000 deaths from malarial fevers (giving a rate from this cause alone of 34·6 per mille of the population), the district boards concerned thought it proper to spend 24 per cent. of their incomes for education, against 1·5 per cent. for sanitation, including nothing for new water supplies. In connection with malarial fevers and "the drain upon the resources of India" they bring about, it is worth remembering that, during 1908, there were treated in the civil hospitals of India (where necessarily but a fraction of the population resort) a total of 5,211,851 cases of malarial fevers.

W. G. KING.

THE VOLUME OF THE KILOGRAMME OF WATER.

THE volume referred to below[1] contains three important memoirs relative to determinations which have been made during recent years by the Bureau International des Poids et Mesures, or under its auspices, on the volume of the kilogramme of water.

Since the fundamental work of Lefèvre-Gineau and Fabbroni, made towards the end of the eighteenth century, on which the prototype standard kilogramme was based, the question of the specific mass of water has been the subject of a number of inquiries in various countries. In spite of the critical and detailed examination to which these inquiries have been subjected, it is not easy to institute an exact comparison between the results, partly because the measures have been made and expressed in units of which the relation to the metric units is more or less uncertain, and partly because certain elements in the reductions and calculations have not been set out in sufficient detail.

A *résumé* of this work is given by M. Guillaume in the first of the three memoirs above referred to. From this account, in which the previous work has been carefully revised, and all corrections introduced, so far as known data would permit, it appears that the most probable values for the mass of a cubic decimetre of water deducible from the most important of the determinations subsequent to those of Lefèvre-Gineau and Fabbroni, are as follows:—

	kg.
1821. Shuckburgh and Kater ...	1·000475
1825. Svanberg, Berzelius, Akerman, and Cronstrand ...	1·000290
1831. Stampfer ...	0·999750
1841. Kupffer ...	0·999931
1893. Chaney ...	0·999850

The original work on which Lefèvre-Gineau and Fabbroni established the first standard kilogramme has also been minutely examined and discussed by several authorities, and M. Guillaume has subjected these revisions to a further scrutiny, from which it would appear that the following are the most probable values of the mass of the cubic decimetre of water:—

		kg.
According to the revision of	Broch (minimum)	0·999880
,, ,, ,,	Mendeléeff	0·999966
,, ,, ,,	Guillaume	0·999970

These numbers, it will be seen, differ notably among themselves, and even after due weight has been given to their relative probable value, it still remains uncertain in which direction the difference between the kilogramme as defined and as it actually is really lies.

The exactitude of these values ultimately depends upon the precision with which the linear and hence the cubical dimensions of bodies can be ascertained. Within recent years great increase in accuracy has been secured in such measurements by the application of the phenomena of optical interference as worked out by Fizeau and Michelson. In 1897 the late M. Macé de Lépinay ascertained the precise dimensions of a cube of quartz by this method and by means of it made a series of determinations of the mass of a kilogramme of water, and obtained the value 0·999959. In 1899, MM. Fabry and Perot made similar determinations by a modification of the method on the same cube of quartz, and found the value 0·999979.

These methods, with all the improvements which experience has suggested, have formed the basis of the series of determinations made by M. Chappuis, on

[1] "Travaux et Mémoires du Bureau International des Poids et Mesures." Tome xiv. (Paris: Gauthier-Villars, 1910.)

one hand, and by MM. Macé de Lépinay, Buisson, and René Benoît, on the other. That made use of by M. Guillaume consisted in ascertaining the measurements by mechanical contact—the old method, in fact, of Lefèvre-Gineau, modified by the refinements of modern metrology. In each of the methods the general problem was the same, namely, to determine by lineal measures referred to the prototype metre, the dimensions, and consequently the volume of a solid of definite geometrical form, say a cylinder or cube of brass, or glass, or quartz, of as perfect a form as possible, and then to ascertain the weight, referred to the prototype kilogramme, apparently lost by the solid when immersed in water. The two parts of this operation are of very unequal difficulty; that of ascertaining the dimensions is by far the more difficult. Thanks to the admirable equipment of the bureau, the hydrostatic weighings could be made with a very high degree of accuracy.

It is impossible within the space at disposal to enter into the details of manipulation or to explain the manner in which the experimental methods were carried out. For information on these points the memoirs themselves must be consulted. The final results, obtained after a careful revision of all the calculations, may be thus summarised:—

Method of Contact.

	cm.	Mass of a cubic decimetre of water (kg.)	Volume of a kilogramme of water (dm^3)	Weighted Mean
Bronze cylinder of	14	0·9999749	1·0000251	1·000029
,, ,,	12	0·9999655	1·0000345	
,, ,,	10	0·9999672	1·0000328	

Interferential Method by Reflexion.

	cm.	kg.	dm^3	
Cube of glass	4	0·9999713	1·0000287	1·000026
,,	5 1st measure	0·9999789	1·0000211	
	5 2nd ,,	0·9999784	1·0000216	
,,	5 reworked	0·9999731	1·0000269	
,,	6	0·9999696	1·0000304	
,,	5	0·9999731	1·0000269	

Interferential Method by Transmission.

	cm.	kg.	dm^3	
Cube of quartz	4	0·9999741	1·0000259	1·000027
,,	5	0·9999729	1·0000271	

With respect to the relative value of the methods of measurement, there can be little or no doubt in M. Benoît's opinion that those obtained by the method of optical interference are to be preferred to the mechanical method of contact. On the other hand, the older method has the advantage that bodies of larger volume can be employed with a corresponding diminution of error in other directions. The three results are, it will be seen, very close together. The final mean falls between 1·00027 and 1·00028, and is rather nearer the first than the second number.

Accepting the sixth decimal as the limit of accuracy, the ultimate result is that 1 *kilogramme of pure water, free from air, at 4°, and under normal pressure, measures* 1·000027 *cubic decimetre; or that the mass of* 1 *cubic decimetre of this water is* 0·999973 *kilogramme.*

The uncertainty of these numbers probably does not exceed 1 in the last figure, or about a milligramme on the kilogramme.

M. René Benoît, the director of the bureau, concludes the *résumé* of the three important memoirs which have led to this result which some general observations on its bearing upon the question of the relation of the actual value of the kilogramme to its original theoretical definition. He justly points out that the original standard kilogramme of Lefèvre-Gineau and Fabbroni was constructed with a perfection truly admirable, and altogether extraordinary when one considers the general state of science and the means at command in their epoch. Their kilogramme was in effect represented by the mass of a cube of water, the side of which measured not exactly 1 decimetre, but 1·000009 decimetre. Even if it be admitted that such a result could only have been obtained by a fortunate compensation of errors, it is certain that a like perfection can only be secured today by observers equipped with all the resources of modern metrology, working with the most scrupulous care, joined to a critical faculty of the highest order in the sifting and discussion of results.

He points out that whilst it might be possible to construct a new standard kilogramme in closer conformity with its definition, there would be little practical gain in so doing. The litre, the volume of a kilogramme of water, is in practical conformity with the cubic decimetre, not only for the needs of ordinary life but for by far the greater number of the requirements of science. Should any case need a higher degree of precision, there would be no difficulty in the application of a correction based upon the conclusions of the present work of the bureau. M. Benoit sees in the general result a proof of the wisdom of the decision of the International Metric Commission of 1872, not to disturb the original standards, but in constituting the international kilogramme as fundamental prototype simply to copy the old kilogramme of Lefèvre-Gineau and Fabbroni.

T. E. THORPE.

NOTES.

PROF. J. H. POYNTING, F.R.S., has been elected a foreign Fellow of the Reale Accademia dei Lincei.

BY the will of Mr. Thomas Lupton, solicitor to the Royal Institution, the institution will receive 10,000*l*. for general purposes.

M. ARMAND GAUTIER will be president of the Paris Academy of Sciences for 1911. M. Lippmann has been elected vice-president.

IT has been decided to establish a laboratory for researches in the chemistry of therapeutics in the Pasteur Institute in Paris. The laboratory will be directed by M. Ernest Fourneau.

ON Thursday next, December 29, Prof. Silvanus P. Thompson will commence the Christmas course of six juvenile lectures at the Royal Institution on "Sound, Musical and Non-musical."

THE Paris correspondent of the *Times* reports that Prof. Guignard, who has acted as director of the Paris School of Pharmacy for the last fifteen years, has resigned his appointment, and is succeeded by M. Henry Gautier, professor of mineral chemistry at the school.

THE Institution of Naval Architects, which was founded in 1860, has received an intimation from the Lord President of the Privy Council to the effect that the King has been pleased to approve of the grant to the institution of a Royal Charter of Incorporation.

A CORRESPONDENT of the *Daily Chronicle* states that a brilliant display of aurora borealis was witnessed at Hampstead on Monday, December 19, between 10.30 p.m. and 11 p.m. The display started in the north-north-west, and the streamers spread across the sky so far as the constellation of Orion.

We learn from *Science* that the Nichols gold medal of the American Chemical Society for the year 1909–10 has been awarded to Prof. M. A. Rosanoff, of Clark University, and his pupil, Mr. C. W. Easley, for their joint study of the partial vapour pressures of binary mixtures. The formal award will take place at the meeting of the New York Section on January 6, 1911.

Referring to the letter from Prof. W. A. Douglas Ridge on the tribo luminescence of uranium in Nature of December 15, Mr. H. A. Kent (The Poplars, Maidstone Road, Bounds Green, N.) writes to say that he noticed similar effects in 1904. He found by filling the tube containing metallic uranium with oxygen the brilliancy was much exhalted.

In continuation of the index volume printed twenty years ago, the Royal Society of Edinburgh has completed an index to the Transactions of the society issued during the years 1889–1908. The volume includes also an address by Sir Wm. Turner, K.C.B., F.R.S., president of the society, delivered at the opening of the new rooms on November 8, 1909.

A prize of 100,000 francs is to be awarded to the inventor of a practical apparatus which will make it possible to save the crews of wrecked submarines, enabling them to regain the surface uninjured. The French Minister of Marine is able to offer the prize, as he has received an anonymous gift from a French lady for the purpose. The conditions under which the prize will be awarded have been officially announced.

A memorial has been erected, says *Science*, at the National Bacteriological Institute in the City of Mexico to the late Prof. H. T. Ricketts, who at the time of his death was assistant professor of pathology in the University of Chicago and professor-elect of pathology in the University of Pennsylvania. His death was caused by typhus fever, which he contracted while conducting researches in this disease.

Among the many curious investigations carried out by means of instantaneous photography, not the least curious are those which Prof. A. M. Worthington, F.R.S., has devoted to the study of the effects produced by the fall of drops or solid spheres into water and other fluid. These investigations will be described and illustrated in this year's Christmas lectures at the Royal Society of Arts by Prof. Worthington.

In his recent annual report the Secretary of the United States points out that the attainment of the North Pole by Commander Peary has added to the honour and credit of the United States. The Secretary of State therefore recommends that Commander Peary should be given a commission by legislation as rear-admiral of the Corps of Civil Engineers of the U.S. Navy, to date from the day of his discovery, and that he be retired as from that date with the highest retired pay of that grade.

The death is reported, at the age of sixty-eight, of Dr. Charles Otis Whitman, for the last eighteen years head of the department of zoology and curator of the zoological museum at the University of Chicago. He had previously held appointments at the Imperial University of Japan, the Naples Zoological Station, Harvard University, the Allis Lake Laboratory, and Clark University. From 1888 to 1908 Dr. Whitman was director of the Marine Biological Laboratory at Woods Hole. He was editor of the *Journal of Morphology* and of the *Biological Bulletin*.

One of the most promising of American pathologists, Dr. Christian Archibald Herter, has died recently at the early age of forty-five. In 1890 he followed up his studies at Johns Hopkins University and Zurich by publishing a text-book on "The Diagnosis of Nervous Diseases." He then devoted himself especially to pathological chemistry, and held for several years the chair of that subject at the Bellevue Hospital Medical School, New York. Since 1903 he had been professor of pharmacology and therapeutics at the New York College of Physicians and Surgeons. Dr. Herter had carried out several scientific investigations for U.S. Government departments. He was treasurer to the Rockefeller Institute for Medical Research, and had himself created two lectureship foundations, one at Johns Hopkins University and the other at the Bellevue Medical School.

At the annual meeting of the Yorkshire Naturalists' Union, held at Middlesbrough on Saturday, December 17, a vigorous protest was made against the action of H.M. Stationery Office in reference to the increased prices which have now to be paid for hand-coloured editions of the maps of the geological department. It was pointed out that in withholding from the public cheap and easy access to the results of the Geological Survey, the objects of the Survey were in large measure defeated, and the cost of this department of the public service deprived of much of its justification. At the same meeting Dr. Alfred Harker was elected president for 1911, Mr. H. Culpin the hon. treasurer, and Mr. T. Sheppard hon. secretary.

The Eastern Telegraph Company report that an earthquake was felt at Zanzibar on December 14 at 11.40 a.m. Greenwich mean time. The shock must have been of great intensity over a wide area, for four of the company's cables between Zanzibar and Durban were broken at about the same time. The first tremors were recorded by the seismograph at Cardiff at about noon, the total duration of the movement there being about two hours.

Two slight earthquakes were felt throughout Glasgow on Wednesday evening, December 14, the first at 8.54 p.m. and the second shortly after ten. The first shock, which was strong enough to make windows rattle and to throw down some ornaments, lasted four or five seconds, and was accompanied by a loud rumbling noise. The area affected by it extends at least twenty-one miles east and west from Glasgow to Greenock, and ten miles north and south from Milngavie to Johnstone. The seismograph record at Paisley Observatory shows a disturbance, one-tenth of a millimetre in amplitude, at 8·54 p.m., and others of larger amplitude, but not connected with the Glasgow earthquakes, at 9.26 and 9.29 p.m., while a slight movement about 10 p.m. may have been caused by the second shock. The record obtained at the Royal Observatory, Blackford, Edinburgh, at about 10.30 p.m. had, of course, no connection with the Glasgow shocks.

In a communication published in the *Morning Post* of December 20 Prof. J. Milne, F.R.S., records the following series of earthquakes:—After a long period of rest we have had a succession of large earthquakes. On December 13 there was one on the West Coast of Africa, which broke several cables, and on December 14 one in Scotland. On December 16 one occurred so far off as New Guinea. On December 17, at 7.30 a.m., one reached us from a place so far distant as the West Indies. Next day, at 4 a.m., one came from Java, and in less than two hours, namely, at 5.49 a.m., there was another disturbance in the West Indies. There was a third at 4.50 p.m. With the exception of the disturbance in Scotland they were all very large, and shook quite half the world.

THE subject of the Neolithic age culture in Malta has been dealt with by Dr. Ashby and by Mr. Peek in the last issue of Papers of the British School at Rome. It has often been remarked that up to the present no cemetery of this race has been discovered. In a letter addressed to the *Times* of December 13 Mr. T. Zammit, curator of the Valetta Museum, announces that he has found on the road between Attard and Nobile an undoubted Neolithic interment. No flint implements were discovered with the remains, but the characteristic pottery and the iron ochre pigment in which the bones were soaked leave no doubt regarding the date of the interment. The discovery is most important, because on this evidence Malta falls into line with Sicily and Italy so far as the Neolithic culture is concerned.

AT a meeting of the executive committee of the British Science Guild, held on December 14, it was reported that a deputation on behalf of the Guild waited on December 2 upon the private secretary to the Prime Minister to represent the undesirability that Government should part with the site at Fosterdown which had been selected by the Solar Physics Committee three years ago as most desirable for the future site of the Solar Physics Observatory about to be vacated at South Kensington. This site, for some unexplained reason, had been put up by Government to be sold on December 13. The memorial protesting against this sale was signed by the surviving members of the Duke of Devonshire's Commission, past-presidents, and a large numbers of Fellows of the Royal Society, and of the British Science Guild. The Prime Minister was pleased to comply with great alacrity with the prayer of the memorial.

THE Franklin Institute recently awarded the Elliot Cresson gold medal, the highest in the gift of the institute, to several men of science. The secretary of the institute has favoured us with a detailed statement of the grounds of the award in each case "for distinguished leading and directive work," from which we extract the following particulars. The award was made to Dr. Edward Weston, Newark, N.J., for "electrical discovery and in the advancement of electrical application"; to Prof. Ernest Rutherford, F.R.S., for "the advancement of our knowledge of electrical theory"; to Sir Joseph J. Thomson, F.R.S., for "the advancement of our knowledge of the physical sciences"; to Sir Robert A. Hadfield, for "the advancement of our knowledge of metallurgical science"; to Dr. Harvey W. Wiley, chief chemist to the Department of Agriculture, Washington, D.C., for "work in the fields of agricultural and physiological chemistry"; to Mr. John Fritz, Bethlehem, Pa., for "work in the development of the iron and steel industries"; and to Dr. John A. Brashear, of Pittsburg, Pa., for "work in the production and perfection of instruments for astronomical research."

THE late Sir George S. Mackenzie, formerly Administrator of the Imperial British East African Company's Territories, left estate of the gross value of 104,004*l.* 19*s.* 6*d.*, of which the net personalty has been sworn at 99,647*l.* 17*s.* 9*d.* The residue of his property is bequeathed to his children in equal shares, and in the event of his leaving no children the following bequests are made:—(1) To the Ross and Cromarty County Committee 2000*l.* on trust to found two bursaries each of the value of 30*l.* per annum, to be known as the "Sir William Mackenzie and the Jessie Mackenzie Inchvannie Bursaries," to be tenable at the Scottish universities for students from Ross and Cromarty, and preferably from the National Schools, for the study of medicine, chemistry, engineering, or agriculture, or other branch of applied science. (2) To the Royal Geographical Society 1000*l.* to found a prize to take such form as the council of the society may see fit, and to be in commemoration of the great work done by the British East Africa Company in saving British East Africa for the British Empire. (3) To the president and council of the Royal College of Physicians and the Royal College of Surgeons, England, 30,000*l.* (subject to life interest of his two brothers), for the endowment of scientific research by students of ability and of registrable medical qualification, who may thus be able to devote their whole energies to such work, and be independent of ordinary practice. This bequest is made in the hope that the combined results of the systematic work of so many trained workers may prepare the way for a genius to come who will make great discoveries.

THE International Exhibition of Hygiene is to be held at Dresden in 1911. The object of this exhibition is in no sense commercial; it is being promoted for purely educational purposes, and it is intended to give hygienists of all nationalities an opportunity of learning what is being done in other countries in the direction of guarding the individual from the many dangers to health which exist, more particularly in our large industrial communities. It will bring home to the public what has been achieved by scientific research in the cause of hygiene, and it cannot fail to offer an impressive object-lesson to a large number of visitors from different countries of the importance, not only from the personal, but from the social and national point of view, of a due regard to the physical welfare of man. There is no doubt that the exhibition will be international in its widest sense, the Governments of far distant countries having already voted considerable sums of money for the proper display of what they have done and what they are doing in the domain of hygiene. To ensure this, the German Government has issued invitations to all the principal nations of the world to take an active part in this philanthropic scheme, and the invitation has been accepted by the very large majority of those to which it was extended. The only great country which stands aloof is Great Britain, a country which is universally regarded as occupying a foremost place among the nations in its appreciation and practical application of the requirements of sanitation. Although our Government, with its characteristic lack of appreciation of scientific work, does not seem disposed to take an official part in this international exhibition, it is to be hoped that money will be obtained from other sources in order to allow Great Britain to be represented adequately.

A CORRESPONDENT, Mr. George Boaq, writing from Aguilas, Murcia, Spain, directs attention to a method devised by Drs. Nasmith and Graham, of the Provincial Board of Health, Ottawa, for destroying typhoid and dysentery bacilli in water, and rendering it safe for drinking purposes. A level teaspoonful of chloride of lime is rubbed up in a cupful of water, the water being added little by little, so as to obtain a uniform emulsion. This is then diluted with three more cupfuls of water, and one teaspoonful of the dilution is added to two gallons of the water to be purified, mixing thoroughly, and the mixture is allowed to stand for at least ten minutes. The directions are somewhat rough and ready, but if the water tastes distinctly of chlorine sufficient chloride of lime has probably been added. A water containing much organic matter will require more chloride of lime than one containing little organic matter. For a water containing little organic matter one part of chloride of lime per million parts of water suffices, but for an impure water four or five parts may be required. If an excess of

chloride of lime be added the water becomes unpalatable, but the taste disappears on standing, particularly in bright sunshine, or may be destroyed by the addition of a dechlorinising agent such as bisulphite of soda. The efficiency of chlorine and chloride of lime for sterilising water has been amply demonstrated by many observers—Nesfield, Rideal, Thresh, Woodhead, and others.

In view of the recent scare of plague in the Eastern Counties, considerable interest attaches to a paper by Captain W. D. H. Stevenson (Scientific Memoirs by Officers of the Medical and Sanitary Departments, India, No. 38) giving a preliminary account of experiments on the killing of rats and rat-fleas by means of hydrocyanic acid, generated by the action of sulphuric acid on potassium cyanide. Fleas were killed very rapidly by the gas. In one experiment a mixture of 1 ounce of potassium cyanide, 2 ounces of sulphuric acid, and 4 ounces of water was placed in a small room of the capacity of about 346 cubic feet, and the door was then closed. After forty minutes the door was opened, and fifteen minutes later the room was entered; all the fleas left in different parts of the room were killed, even those placed inside four bags, three of blanket and one of cotton, but some of the fleas placed inside a box of clothes survived. Rats were found to require more gas and a longer exposure than fleas. On the other hand, plant-life appears to be uninjured by the gas, and cultures of bacteria were also unaffected by it. Dried grain is not made poisonous for food by the gas, nor are its powers of germination impaired in any way. Moist food-stuffs, however, such as water, milk, butter, and flesh, are said to absorb the poison, and should therefore be removed from a building during fumigation. The gas has no action on metals or fabrics.

That dorbeetles and their kindred are generally infested with mites in this country is a well-known fact, but it appears to be a comparatively new discovery that in Ceylon beetles of this group are likewise infested by minute species of flies. In the December number of the *Entomologist's Monthly Magazine* Mr. J. E. Collin describes a new species of small hairy flies of the genus Limosina taken from a coprophagous beetle in Ceylon. The flies were found clinging to the under surface of the beetle, and, instead of attempting to fly away, allowed themselves to be dropped into a collecting tube without change of position.

In *British Birds* for December it is stated that about 7900 birds were ringed in this country during the year, Messrs. Smalley and Robinson having marked no fewer than 2313 out of this number. In the editor's opinion it is at present too early to decide whether the results will repay the trouble and expense involved in marking. Its chief results will relate to the movements of individual birds, and it is urged that special attention should be paid to the recapture of the smaller marked birds by the editor's correspondents, most of those which have been taken having fallen into the hands of persons unacquainted with the scheme. The costs of the inquiry during last year considerably exceeded the funds at the disposal of its promoter, and if the scheme is to be continued next season it can only be by the aid of special subscriptions.

In the Proceedings of the United States National Museum (vol. xxxix., 1910, pp. 37–91) Mr. R. E. Snodgrass, whose treatise on the structure of the honey-bee was noticed in Nature of December 8 (p. 169), publishes an important memoir on the thorax of the Hymenoptera. In this paper the modification and elaboration of the thoracic skeleton in the various families of the order are described in detail, and illustrated by nineteen text-figures and fifteen plates. The author finds no support for Verhoeff's theory that each thoracic segment is a complex of three primitive somites, but prefers to regard the serially arranged sclerites of the mesonotum and metanotum—so fully shown by many Hymenoptera—as evidence of specialisation.

In vol. v., No. 3, of the *Philippine Journal of Science* Mr. L. E. Griffin publishes additional information with regard to the pearl-fishery, dealing in this instance with the products obtained off Bantayan, an island lying between the northern ends of Negros and Cebu, at the head of the Tañon channel. In May and June, and again in November and December, the water is usually so still and clear that the bottom can be seen to a depth of eight fathoms, and it is at these seasons that the natives look for oysters. In place of forming banks, these occur sporadically, and were it not for the shortness of the season there is little doubt they would long ago have been exterminated. The shells, although of relatively small size, are of excellent quality, but they are chiefly valuable on account of the large percentage of pearls they yield and their fine quality. During the present year one pearl of the value of 80*l.* was collected, while others worth from 20*l.* to 40*l.* each were obtained. The total annual value of the fishery is about 900*l.*

A survey of the vegetation on the Kasatzkisch steppe, near Kursk, is contributed by Mr. V. Alechin to the botanical section (part ii.) of *Travaux de la Société des Naturalistes de St. Pétersbourg* (vol. xli.). The main feature is the great predominance of dicotyledons, although *Carex humilis* takes an important part in the ground cover. The author concludes that the steppes existed previously to the wooded areas, and that they have been but little modified by human agency.

The suitability of bamboos and lalang, or cogon grass, for making paper pulp is considered by Mr. G. F. Richmond in an article on Philippine fibres published in the *Philippine Journal of Science* (Section A, vol. v., No. 4). Proceeding upon evidence furnished by other investigators and by laboratory experiments, the author takes a favourable view of the prospects of a local soda pulp mill for treating bamboos, and supplies an estimate of the probable cost. Also it is stated that a supply of raw material and the necessary fresh water could be obtained in several localities.

Bud-rot disease of palms has been notified within recent years from the West Indies, Ceylon, India, and the Philippine Islands, but in most cases the cause of the disease has not been definitely established. Dr. E. J. Butler, who has conducted the investigations in India, where palmyra palms are chiefly attacked, attributes the disease there to a Pythium, deriving his conclusions from the inoculation of healthy palms. The source of the disease in the other countries, where cocoanut palms are infested, is probably different. Dr. Butler has embodied his latest researches, together with a general account of the distribution and remedial measures adopted, in the botanical series (vol. iii., No. 5) of the Memoirs of the Department of Agriculture in India. Two spore forms are recognised; in the ordinary case the contents of a sporangium break up into zoospores, but in hot, dry weather a resting variety of conidium is more commonly found.

THE Journal of the Royal Society of Arts for December 9 contains a paper delivered to the society by Mr. A. Montgomery, State Mining Engineer of Western Australia, on the progress and prospects of mining in Western Australia. Mr. Montgomery states that the metallic minerals occur in very old igneous and sedimentary rocks, which are almost certainly pre-Cambrian. His conclusion is that Western Australia owes the present shape of its surface largely to submergence beneath the sea within post-Tertiary times. The paper was accompanied by an exhaustive statistical appendix, from which we find that for the quinquennium 1903–7 the world's production of gold was 76,000,000*l*., of which the Commonwealth of Australia contributed 20 per cent. and Western Australia $10\frac{1}{2}$ per cent. For the same quinquennium the gold produced has been more than 96 per cent. of the total mineral production, and the mineral export from Western Australia has been 80 per cent. of the total for all the exports from the colony. The value of gold produced per man employed has been more than 400*l*. during the years 1908–9. In regard to the help afforded by the Government to the mining industry, attention is directed to the extensive development of the railway lines and of the systems of water supply; water is sold to the mines at from 4*s*. 9*d*. to 8*s*. 6*d*. per 1000 gallons.

THE November number of *Petermann's Mitteilungen* contains an interesting map of Siberia taken from one published by the Russian Academy of Sciences, which shows the distribution of places where remains of the mammoth and rhinoceros have been found. Most of them lie within the Arctic circle, but one of the former and three of the latter sites lie further to the south.

AN event of much interest in cartography is the completion, after about thirty years' work, of the 1 : 100,000 map of Germany in 675 sheets. A full account of these maps and the various stages in their development and their production is given by Colonel v. Zglinicki, chief of the cartographic section of the Prussian Survey, in a recent number (No. 9) of the *Zeitschrift der Gesellschaft für Erdkunde*.

THE determination of the international boundaries in Africa proceeds apace, and in Heft 4 of the current volume of *Mitteilungen aus den deutschen Schutzgebieten* are published the latitudes and longitudes which were determined in 1905–7 along the boundary which divides the Cameroons from the French Congo. Neither the time available nor the funds at disposal sufficed to carry out a chain of geodetic triangulation along the boundary, so that it was necessary to rely on astronomical observations alone. Latitudes were determined by circummeridian altitudes of north and south stars, and longitudes by lunar observations, and in three cases only by star occultations. Observations made at the observatories of Greenwich, Paris, and Göttingen were utilised to furnish the final corrections, the uncertainty of the results being ± 2 to ± 5 seconds.

UNDER the title of "The Burial of Olympia," Prof. Ellsworth Huntington in the *Geographical Journal* for December applies the theories advocated in his work "The Pulse of Asia" to the problem of the decadence of Greek civilisation. This is often attributed to deforestation; but from evidence collected in America by Prof. Moore, chief of the United States Weather Bureau, he denies that this can have played an important part in the ruin of the natural resources of Greece. He assumes that pulsatory changes of climate, such as the rapid desiccation of parts of Asia, may have occurred in Greece in the millenium preceding 600 A.D. To these he attributes many of the world's greatest movements of population, such as the attacks of the barbarians on southern Europe, the invasions of Genghis Khan and Tamerlane, and he connects with these the spread of malaria due to the introduction of the mosquito, for which Greece now became a fitting habitat. In the instructive discussion which followed, these views were criticised by Prof. Myres, Dr. Hogarth, Dr. Stein, Prof. Gregory, and others, most of whom, while admitting the novelty and interest of Prof. Huntington's suggestions, desired further evidence. This may perhaps be gained from Prof. Huntington's recent work in the American deserts; but until the question of North Africa is settled the general problem cannot be finally decided.

IN the *Popular Science Monthly* for December Prof. S. W. Williston discusses the birthplace of man in the light of the palæontological record. The evidence, he suggests, points to the conclusion that it was in India and its borderlands that the chief domesticated animals were specialised—the genus Bos in the Indian Lower Pliocene, the swine, horse, elephant, and the cat tribe; among birds, the ostrich, jungle-fowl, peacock, and grey goose. Man may have been developed in this region during the Late Miocene or Early Pliocene periods. He believes that within a very few years the discovery of indubitable links in man's ancestry will be made in Central Asia, China, or North India, there being no other region to which the palæontologist looks with more eager expectation for the solution of many profound problems in the phylogenetics and migrations of mammalian life.

THE Transactions of the Leicester Literary and Philosophical Society for 1910 contain two geological papers of interest. Mr. F. Cresswell deals with the frequently discussed question of the origin of the English Triassic strata, with special reference to the Keuper marls. He suggests that the grey bands represent periods of moister climate, when minute organisms reduced the peroxide of iron to protoxide. While regarding the floor on which the English Trias was deposited as a rocky tableland, he falls into a very common error by stating that the Libyan Desert differs from this, being "a uniform sandy plain." Mr. Cresswell fully supports the view that desert conditions prevailed in Triassic times in England, and urges that the Keuper marls are formed of particles worn from igneous and metamorphic rocks by "weathering with a very limited amount of water." Mr. J. McKenzie Newton contributes an essay on the crystallisation of igneous rocks.

IN the Bulletin of the Central Meteorological Observatory of Japan (No. 5, 1910) Mr. T. Okada discusses in great detail the rainy season in Japan, which usually extends from about the middle of June to the middle of July, and is the most important period for the cultivation of rice. To make the investigation more complete, five-day means are given for the whole year for a large number of stations in Japan and adjacent districts, with charts and a short discussion of each of the principal elements. The figures show that in Japan proper the rainfall reaches a maximum at the end of June or in the first decade of July; it then falls to a minimum in August, and again increases to a maximum in September or October. The rainfall of the season in question is chiefly caused by cyclonic disturbances from the Yangtse Valley and Formosa, and is not a simple monsoon rainfall. The period is characterised by continued cloudy weather, large relative humidity, comparatively high temperature, small wind-velocity, and more or less rainfall every day. The discussion extends to eighty-two quarto pages.

The use of the Clark and Weston cells as standards of electromotive force has necessitated a close study of the properties of cadmium and zinc amalgams, and numerous valuable papers on this subject have issued from the van 't Hoff laboratory at Utrecht. In the current number of the *Zeitschrift für physikalische Chemie* (December 2) is a further contribution from this laboratory by Ernst Cohen and P. J. H. van Ginneken, dealing with the properties of zinc amalgam as affecting the Clark cell. The authors conclude that the formula in current use representing the relation between the E.M.F. and the temperature of the Clark cell is not trustworthy, and should not be employed in accurate measurements. It is further shown that for exact work the Clark cell must be used at temperatures between 20° C. and 38° C.

The Department of Mines, Canada, has sent us a copy of the report of analyses of ores, fuels, &c., made in the chemical laboratories of the Geological Survey during 1906 and 1907, and of the Mines Branch of the Department of Mines in 1906, 1907, and 1908. With the exception of twenty-seven rock analyses, the work done is chiefly of practical interest, analyses being given of numerous coals, lignites, peats, and ores of iron, copper, and chromium. The results of seventy-seven gold and silver assays show the wide distribution of the precious metals in Canada. In an appendix a description is given of the commercial methods and apparatus used for the analysis of oil-shales.

Messrs. Whitcombe and Tombs, Ltd., will publish shortly a fully illustrated work on "Australian Plants" suitable for gardens, parks, timber reserves, &c., by Mr. W. B. Guilfoyle.

OUR ASTRONOMICAL COLUMN.

A Projection on Saturn's Outer Ring.—During the total eclipse of the moon on November 16 M. Jonckheere directed the 35-cm. equatorial of the Hem Observatory to Saturn, and found a bright projection extending outwards from the eastern extremity of the exterior ring. The projection was best seen with low powers (100 and 200), and its intensity decreased gradually, going from the outer edge of ring A on to the background of the sky. On November 20 and 24 the same projection was seen with difficulty (*Astronomische Nachrichten*, No. 4461).

Discovery of Another Nova, Sagittarii No. 3.—In a note appearing in No. 4459 of the *Astronomische Nachrichten* Prof. E. C. Pickering states that Miss Cannon has found that a new star appeared in the constellation Sagittarius on August 10, 1899. A photograph taken on August 9, although showing stars of magnitude 11·5 in the immediate neighbourhood of the nova, shows no trace of it, yet on August 10 it is a conspicuous object of magnitude 8·5. While the outburst was so sudden, the decline, as is common with such objects, was very rapid, for the light faded from 8·6 on August 25 to 10·5 on October 13, 1899; the decrease after that date was more gradual. The nova is not shown on any photograph taken after October, 1901, when its magnitude was about 13·0. The position of this object was R.A. = 18h. 12·2m., dec. = −25° 14′ (1875·0); this is about 10m. west of λ Sagittarii and 20m. east of Nova Sagittarii No. 2.

Faye's Comet.—Having identified Cerulli's comet with Faye's short-period comet, M. G. Fayet has investigated the orbit with the idea of obtaining closer agreement with Dr. Strömgren's elements. Employing three observations, made between November 10 and 22, he calculated the value for the mean motion and obtained two sets of elements, which, however, were not altogether satisfactory. Then on November 30 he secured a further observation, and this enabled him to apply the method of the variation of geocentric distances and to calculate other systems, the fifth of which agrees very nearly with Dr. Strömgren's elements for 1903, except that the mean motion is 486·792″ instead of 480·16″; they also give a close agreement with the observations. From the best system obtained, which may, however, yet be improved, M. Fayet has calculated an ephemeris giving daily positions up to January 30, 1911 (*Astronomische Nachrichten*, No. 4461).

New Experimental Demonstration of the Earth's Rotation.—An interesting description of an experiment devised by Father Hagen to demonstrate the rotation of the earth is described by M. B. Latour in No. 1346 of *Cosmos* (November 12). Father Hagen's apparatus consists of a balanced beam of wood, 9 metres long, which has a bifilar suspension, and to which is attached heavy masses movable in the horizontal plane towards and away from the suspension. In the modified experiment these masses each consist of 80 kilograms of lead mounted in small waggons, which can be automatically released by the fusion of a leaden wire. When released the waggons run towards the centre, the moment of inertia of the beam is modified, and it swings relatively to the earth; the motion is shown by a mirror attached to the suspension and reflecting a beam of light on to a scale fixed on the wall of the circular room wherein the apparatus is installed. When the chariots are made to run from the centre to the extremities the swing of the beam is in the opposite direction and about half the amount. With Father Hagen's apparatus, mounted in the massive tower which carries the astrographic equatorial at the Vatican Observatory, the mean of twenty experiments gave a value for the earth's rotation very near the theoretical value at Rome.

Investigation of the Orbit of Wolf's Comet, 1898–1911.—In No. 4460 of the *Astronomische Nachrichten* M. M. Kamensky gives in brief the results of an elaborate investigation he has made of the movements of Wolf's comet during the period 1898–1911. This is the well-known short-period (6·7 years) comet discovered by Wolf at Heidelberg on September 17, 1884, and independently by Copeland with the spectroscope on September 22; it was reobserved in 1891 and 1898, but was not seen in 1904–5. The orbit was completely transformed by Jupiter in 1875, but the slight differences between the observed and calculated places in 1898 indicate that it is now a permanent member of our system.

M. Kamensky first investigated the motion during the period 1898 August 22 to 1904 June 12, taking into account the perturbations of the earth, Mars, Jupiter, Saturn, and these are published in full in No. 15 (1910) of the *Bulletin de l'Academie Impériale des Sciences de St. Pétersbourg*. He then carried the investigation forward to March 28, 1911, and publishes the full tables in No. 16 of the Bulletin; he also gives elements showing the severe perturbation by Jupiter in 1875, and states that extraordinary changes may again take place at a near approach in the latter part of 1922.

According to the final elements, the next perihelion passage should occur on February 24, 1912, and in Bulletin No. 16 M. Kamensky gives an ephemeris for the period 1911 January 3 to October 14; for the latter date the estimated magnitude is 12·2.

The Light Changes of Forty-nine Variable Stars.—In the fourteenth issue of the *Bulletin International*, published by the Cracow Academy of Sciences, Dr. L. Pračka discusses the light changes of forty-nine variable stars. The observations were made at the Bamberg Observatory during 1905–9, and each star is discussed at length. A summary of the results is given in handy tabular form at the end of the paper showing the elements, the magnitudes and colour, and the form of the light-curve for each object.

THE PHYSICAL SOCIETY'S EXHIBITION.

On Tuesday, December 20, the Physical Society of London held its annual exhibition of physical apparatus, and the occasion was marked by some interesting experimental lectures. Prof. J. A. Fleming, F.R.S., chose for his subject some improvements in transmitters and receivers for wireless telegraphy, and referred first to his well-known oscillation valve, consisting of a glow lamp in which a metal plate of some convenient form is

fixed. When the filament (which in the latest form is of tungsten) is glowing, a current will flow if an E.M.F. is applied between the negative terminal of the filament and the metal plate; the current can flow from the filament to the plate, but not in the reverse direction, and thus rectification results. Owing to the upward trend of the conductivity curve a much higher sensibility is obtained by applying a certain constant E.M.F. on which that due to the oscillations is superimposed. Passing to the question of the spark, the lecturer reproduced some interesting records showing how greatly the secondary current is increased when the spark gap is subjected to an air blast. Finally, Prof. Fleming showed his new form of spark discharger. This is of the Wien "quenched-spark" type, and consists of two heavy steel circular discs, one above the other, very perfectly surfaced and with an air gap of $\frac{1}{4}$ mm. between them. The lower disc is stationary and the upper one is rotated. The discs are placed in oil, and as there is a hole in the lower disc there is a continual circulation of oil. The discharger is found to give very satisfactory and uniform results, and has been used for measuring losses in condensers.

Mr. R. W. Paul gave several demonstrations of kinematograph diagrams. One series, due to Prof. R. W. Wood, illustrated sound waves; but certainly the most effective films were those due to Prof. S. P. Thompson, F.R.S., showing the movement of lines of force as a keeper approaches a magnet, the starting of a current in a solenoid, the rotation of a dynamo armature (in section), and other similar phenomena. These must have appealed strongly to teachers of magnetism.

As regards the apparatus exhibited, it may be said that there were many interesting new instruments, though perhaps nothing very striking, and there was much excellence in many exhibits that were not essentially novel. Thus in optical work A. Hilger, Ltd., gave an excellent display of spectroscopic instruments and a beautiful demonstration of anomalous dispersion. R. and J. Beck showed a small spectroscope giving large dispersion and with a sine motion so as to give wave-lengths direct. Carl Zeiss, as usual, gave an interesting exhibit, including the movement of gold particles (stated to be about 6 $\mu\mu$ in size) in colloidal solution, a special "cardioid" condenser being used, consisting of two lenses combined, and so shaped that a top illumination is secured for a dark ground, although the beam of light comes from below the centre of the stage. Messrs. E. Leitz showed a large projection apparatus giving excellent definition.

Photometric apparatus was not so much in evidence as on former occasions, but R. and J. Beck, and also Everett, Edgcumbe and Co., showed very small portable photometers for measuring surface brightness and illumination. As an exhibit of general interest may be mentioned that of Strange and Graham illustrating flapping flight. Two wings are worked by "Vilcar" mechanism, and a distinct upward pull is noticeable, apparently due to the upward path of the wing differing from that on the downward stroke.

The largest number of exhibits, as usual, were electrical. Several interesting thermo-electric exhibits were shown by the Cambridge Scientific Instrument Co., among which may be mentioned an arrangement for keeping the cold junction of a clinical recording thermometer at a constant temperature. This junction is covered by a small Dewar vacuum vessel, and is surrounded by a heating coil, which comes into action as soon as the temperature falls below a certain value; by this means the temperature of this junction is maintained constant to 0·1° C. This firm also showed compensating leads consisting of copper and copper-nickel alloy; these are run in series with the pyrometer, and, being thermo-electrically equal to the platinum/platinum-iridium couple, they transfer the cold junction of the pyrometer to the galvanometer, thus securing less variation in temperature of the cold junction. An arrangement whereby a constant E.M.F. is obtained for applying to a pyrometer so as to secure a false zero was also shown, and we noticed a convenient piece of apparatus for tracing recalescence curves; also an improved form of C. T. R. Wilson's tilting gold-leaf electroscope. A new form of radiation pyrometer which does not require focussing was shown by the Foster Instrument Co., who also exhibited some special thermo-junction alloys. H. Tinsley and Co. showed a set of instruments largely due to Dr. C. V. Drysdale, and some interesting vector diagrams of alternating magnetic flux in an iron wire, obtained by Drysdale's alternate-current potentiometer. This firm also showed a simple and strong form of vibration galvanometer based on the familiar Kelvin galvanometer; a heavy permanent magnet is provided for the control, and the tuning is effected (without affecting the zero) by magnetically shunting this magnet to the desired extent. The alternating current traverses a small coil, which can be easily changed, and the makers state that the instrument can be used for alternating pressures down to 1/100th micro-volt. R. W. Paul exhibited a well-designed new type of decade standard resistance box with switch contacts, the case being filled with oil, and we noticed some new transforming apparatus by Leslie Miller and by Muirhead and Co. Since there were thirty-five exhibitors, we need scarcely say that there was a good deal to be seen, but in the above notes we have only been able to refer very briefly to a few of the more interesting items.

INVESTIGATIONS ON WHEAT IN INDIA.[1]

THE importance of the wheat crop in India is not always realised at home. Until the last few years we received more wheat from India than from Canada or Australia—sometimes more than from both countries put together. At the present time wheat represents some 7 per cent. of the total value of merchandise exported from India, but the amount exported is only about one-tenth of the total production, the remaining nine-tenths being consumed in the country itself. When an industry has reached such great dimensions without excessive nursing it is clear that those engaged in it have consciously or unconsciously adopted tolerably satisfactory methods of working, and any attempt on the part of an outsider to effect improvements must be developed cautiously. When in 1906 the Indian Board of Agriculture decided to take up the matter seriously, they entrusted the work to Mr. and Mrs. Howard, and subsequent events have amply justified the wisdom of their choice. Several important papers have been issued, and finally a volume, "Wheat in India," in which the authors summarise the present position of the problem and indicate the lines on which advancement may be hoped for.

Mr. and Mrs. Howard devote the first half-dozen chapters of their volume to a general sketch of wheat-growing in India. Wheat is fairly widely distributed over the country, but the areas where it is really important all lie to the north or on the Central Plateau above the Ghats. In the north-west a great deal of the wheat is irrigated; the Punjab is especially well suited to canal irrigation by reason of its never-failing snow-fed rivers and its level tracts of land, but recourse is also had to irrigation by wells. On the other hand, in the Central Provinces, Bengal, and Bombay, only a small area is artificially watered.

In general, the soil is thoroughly well ploughed or scarified during the monsoon and previous to sowing, as many as fourteen ploughings being sometimes given. A good deal of manure is applied in the northern districts, but usually to the maize crop preceding the wheat; in the Central Provinces the monsoon (*kharif*) crop of rice, which precedes wheat, is slightly manured, but in Bombay the irrigated wheat itself is manured. Harvest begins in the Central Provinces in March, elsewhere in April, May, and even the end of June in the frontier districts. The wheat for export has to be got to Karachi for shipment as soon as possible, or it rapidly deteriorates, and is attacked by moths and weevils. In the rush the railway resources are heavily taxed, just as they are in Canada; the Indian case is, indeed, the worse, as there is no elevator system.

These preliminary chapters are illustrated by maps,

[1] "The Milling and Baking Qualities of Indian Wheat." No. 2. By Albert Howard and Gabrielle L. C. Howard.
"The Influence of Environment on the Milling and Baking Qualities of Wheat in India." By Albert Howard, H. M. Leake and Gabrielle L. C. Howard. (Pusa: Agricultural Research Institute.)
"Wheat in India, its Production, Varieties, and Improvements." By Albert Howard and Gabrielle L. C. Howard. Pp. ix+288. (Calcutta: Thacker, Spink and Co. London: W. Thacker and Co., n.d.)

quotations and statistics, and give an illuminating account of wheat-growing in India.

Passing on to a discussion of experimental work, the authors point out that manurial trials on orthodox lines are of purely academic interest in India. It was no doubt an excellent thing to make them, but their value is limited by the fact that the cultivator cannot usually buy the necessary manures. It is much more to the point to make cultivation trials, seeing that labour is very cheap and the labourer realises the necessity for working the land. But here again intelligent planning is necessary; if the trials are to serve as demonstrations for the native they must be made with implements he can afford to buy and learn to handle, and which the village blacksmith can repair. A summary is given of the well-known Cawnpore experiments, which show that the nitrogen supply is the limiting factor in normal conditions of moisture and temperature obtaining there. At Nagpur nitrogen was also the most important factor, but the water supply was in this case near the limit. The Punjab irrigation experiments, said to be the best of their kind in India, were made to ascertain the best quantity of water and the best number of waterings. It was found that the native was, like many other irrigation farmers, taking too much water, so that the area under treatment was needlessly curtailed, and the revenue suffered loss. But the authors further point out that over-watering gives rise to mottled grain and to samples uneven in texture, and therefore of low value. This loss in value, of course, falls on the cultivator himself, and if it could be brought home to him would, no doubt, induce him to take less water.

The authors then discuss the factors adversely affecting the production of wheat in India. In order of merit these are climatic extremes, fungi, insects, and vermin. Of the diseases, rusts are the most important, transcending in effect all other diseases put together. The only trustworthy remedy at present known is to grow rust-resisting varieties. Introduction of such wheats of high repute from abroad proved to be useless; wheats resistant in Australia succumbed badly in India, and, indeed, were more susceptible than the indigenous kinds, besides ripening too late. It therefore became necessary to raise new varieties from Indian wheats, and this work was begun by the authors in 1905. The first step was to take stock of the native sorts. An ordinary Indian wheat-field contains a mixture of several sub-varieties, which had to be isolated. These in turn comprise several types, agriculturally distinct, though botanically identical, and within each type individual variations occur. Selection was carried on, not on the old mass-selection lines, but by isolating single plants and studying their progeny in succeeding generations. The separation of forms and of pure lines has been successfully accomplished, and already several wheats have been obtained which are of much greater value than the mixtures at present in cultivation. Indeed, five of the Pusa selections have been shown by milling and baking tests to be in the same class with the Canadian spring wheats, the strongest and most valuable on the market. When the botanical survey was well on to completion it was possible to hybridise. This work is now in hand, and it is to be hoped that Mr. and Mrs. Howard will be able to carry the hybridisation on for the necessary length of time, so that the full benefit of their survey and selection work may be obtained.

A list of the botanical varieties of wheat found in India is then given, and for certain provinces the agricultural varieties as well. This survey is still in progress.

Throughout the book and the papers which the authors have issued the various wheat problems of India are handled in a masterly way. The record of work done reflects the highest credit on the authors, and is full of promise for the future of Indian agriculture.

THE REDUCTION OF ROLLING IN SHIPS.

REFERENCE is made in *Engineering* for December 16 to a paper by Mr. H. Frahm at the November meeting of the Schiffbautechnische Gesellschaft, in which the author describes his apparatus for reduction of rolling in ships. In this apparatus two water tanks are disposed on opposite sides of the centre line of the ship near the shell, and are connected below by a water conduit and above by an air conduit; a throttle valve is inserted in the latter. The water tanks are filled partly with water, which may oscillate in the closed circuit formed by the conduits. If the throttle valve is closed oscillation is practically prevented; with the valve full open the oscillations are unobstructed, excepting that free waves cannot arise.

The principle on which the device is based is that a series of wave-impulses will cause the ship to oscillate about its longitudinal axis; these oscillations will become pronounced when the period of the waves agrees with that of the natural vibration of the ship. These differ in phase by 90°, *i.e.* the maximum deflection of the ship from the vertical will occur a quarter period after the wave has been at its maximum inclination to the ship. The same applies to the oscillations of the ship and to those of the water column in the tanks, which rises and falls so that the two oscillation periods are equal, provided the water has the proper mass. In this case the oscillations of the water column will lag a quarter period behind those of the ship, and hence half a period behind the period of the waves, and the two turning moments acting on the ship will therefore oppose one another. This is an application of the principle of resonance.

Mr. Frahm's apparatus is beyond the mere experimental stage. The oil-tank boat W83 of the German Navy, 446 tons displacement, is a very stiff boat, with a high natural vibration period of 10·75 per minute. In dock the deflections from the perpendicular were reduced from 10° to 2° by twelve oscillations when the tanks were cut out, and by two oscillations with the tanks in action. At sea the amplitude of rolling was diminished to one-third. Two steamers of the Hamburg-America Line—the *Ypirango* and *Corcovado*—of 12,600 tons displacement, have been fitted with the anti-rolling tanks. The former was a notorious roller. Both are now regarded as steady boats; the tanks reduce rolling 11° (on either side) to 2½° maximum. Messrs. Blohm and Voss are designing anti-rolling tanks for the new passenger steamer of 55,000 tons which they are now building for the Hamburg-America Line. The paper in itself is very interesting, and is doubly so in view of statements made recently in the case of the loss of the British steamer *Waratah*.

ARGENTINE METEOROLOGICAL RESEARCH.[1]

THE services rendered to meteorology by Dr. W. S. Bruce in founding the meteorological observatory at Scotia Bay, South Orkneys, in 1903, are brought into forcible evidence by the publication of successive years' observations. Through the exertions of Dr. Escalante, Minister of Agriculture, and the enthusiasm of Mr. W. G. Davis, the Argentine Meteorological Office was enabled to take over the observatory from the Scottish National Antarctic Expedition, and has maintained it ever since. It must be remembered that this is the only permanent meteorological observatory in Antarctic regions. The observations for 1904, with an introduction by Mr. R. C. Mossman, are now published, though the title-page is dated 1905. The observations of following years seem not yet to have appeared, but they are briefly summarised in a most interesting and useful outline by Mr. W. G. Davis on the climate of the Argentine Republic. It may be mentioned, also, that a discussion by Mr. Mossman of each successive year's observations has appeared year by year in the *Scottish Geographical Magazine*. The tardy appearance of the 1904 volume detracts somewhat from its interest in view of our knowledge of the six later years, but we understand that circumstances beyond the control of the Meteorological Office alone delayed the publication.

Previous to the expedition of the *Scotia* it was supposed that, from their latitude, the South Orkneys would enjoy an oceanic climate. Actually, however, these conditions only obtain for four months, while for the rest of the year the conditions are continental. In exceptional years either of these states of climate may be prolonged at the expense of the other. The climate largely depends on the distribution of ice in the Weddell Sea. The average mean

[1] Anales de la Oficina Meteorológica Argentina. Tomo xvi., Observaciones de las Islas Orcadas en el Año 1904. Text in both Spanish and English. (Buenos Aires, 1905.)
"Climate of the Argentine Republic." By W. G. Davis. (Buenos Aires: Department of Agriculture, 1910.)

monthly temperature for five years (1903–8) varies from 9·68° F. in July to 32·54° in January, while the absolute range in the same period was 88°. The temperature variability of the seasons brings out the tendency to a winter continental and a summer oceanic climate. These values are (1904):—spring, 5·1°; summer, 1·3°; autumn, 5·4°; winter, 9·1°. The year 1904 had a mean annual temperature of 22·4°, which is 0·96° below the average mean of the five years 1903–8.

The wind directions, which were taken from the movements of the lower clouds, since the high land to the west of the observatory tended to deflect many winds, show a prevalence of north-westerly winds. Subsequent years' observations give west and south-west winds as the most frequent, which seems to show that the readings of 1904 give too high a value to north-west winds. Undoubtedly the position of Omond House is such that west and south-west winds would tend to be below what would be recorded in an unexceptional situation. In fact, on further consideration, Mr. Mossman has, we understand, come to the conclusion that the wind directions of 1904 are not wholly trustworthy. East, and especially north-east, winds are conspicuously rare, and the percentage wind frequency for each season does not materially differ from that of the year. The temperatures associated with these winds are of great interest, but unfortunately in Mr. Davis's five years' summary no thermal wind-roses are given. Very probably the high temperatures associated with some of these apparent westerly winds is partly due to Föhn effects, since in May, 1903, that is, in midwinter, an undoubted Föhn wind raised the temperature at the site of the observatory to 46°, which was only 1° lower than the absolute maximum of the year.

Associated with these prevailing west and south-west winds, which were also experienced by Dr. Nordenskjöld at Snow Hill in 1902–3, there exists a low-pressure area in the Weddell Sea, furthest south in autumn and most northerly in winter, but with a centre normally about 66° S. and 30° to 35° W. The continental origin of these prevailing winds accounts largely for the low temperatures of the South Orkneys compared with their latitude. The thermal gradient on the east of Graham Land is steep, and this fact, in relation to the southward bending of the isotherms about 40° W., is strong evidence for the existence of the northward projection of Antarctica south of the South Orkneys to about the Circle. Moreover, on no other grounds is it possible to account for the very low temperatures that occur from time to time at Scotia Bay with southerly and south-easterly winds.

NATIVE WORKING OF COAL AND IRON IN CHINA.

AN interesting illustrated article on the native working of coal and iron in the province of Shansi, China, appears in *Engineering* for December 2. In the Ping Ting Chau districts the iron ore is of excellent quality. The methods of extraction are decidedly primitive; in the old workings the ground is often found honeycombed with small shafts, seldom more than 14 inches in diameter, and usually just large enough to allow a man to go down. The tools used consist of a native pick, a cast-iron hammer, a wedge, and a sort of basket-shovel, the ore being raised in the basket by a small wooden winch. The climate is healthy, but work under such conditions is sure to produce disease, and consumption is very prevalent. During the summer the mines are shut down, and all the men become farmers until the close of the harvest season. The southern district specialises in wrought-iron goods, for example, spades, picks, nails, wrought-iron bars, and general ironwork; the northern district produces the larger and rougher classes of goods, such as cast-iron pans and sections of tyres for cart-wheels. Reduction of the ore is conducted in roasting-kilns; the broken-up ore is mixed with anthracite and charged into clay crucibles, which are heated in the kilns for about four days. The iron residue is then treated in a foundry, where it is broken up and remelted in crucibles for the production of cast iron, or, if wrought iron is being produced, by melting in a crude furnace, hammering, and puddling.

The Ping Ting Chau district is one of the largest anthracite coal beds of which there is any knowledge. The natives get at the coal by adit or by shaft, as may best suit the nature of the ground. Shafts vary from 6 to 8 feet in diameter, and from 60 to 300 feet in depth; the thickness of the seam of coal varies from 4 to 18 feet. During late years native mechanics have been giving advice, with the result that collieries are coming into existence in which the coal is hoisted in baskets, and cow-hide bags are used for hauling out accumulations of water. A Canton Chinaman attempted to apply up-to-date methods to a mine just outside the Ping Ting Chau area, and sank a shaft beside the adit. He proposed to use a winch for winding up the coal, but before this could be done water was struck and the mine flooded. Boilers and pumps were erected by Chinese workmen, and the water was successfully cleared out of the first level. Shortly after starting work an explosion took place, and practically closed the shaft. At present the men are carrying the coal up the steps in bags in an excessively high temperature due to the steam-pipes, and the Cantonese has retired from the field. Pick, hammer, and wedge are the only tools used.

THE DYNAMICS OF A GOLF BALL.[1]

THERE are so many dynamical problems connected with golf that a discussion of the whole of them would occupy far more time than is at my disposal this evening. I shall not attempt to deal with the many important questions which arise when we consider the impact of the club with the ball, but confine myself to the consideration of the flight of the ball after it has left the club. This problem is in any case a very interesting one; it would be even more interesting if we could accept the explanations of the behaviour of the ball given by many contributors to the very voluminous literature which has collected round the game; if these were correct, I should have to bring before you this evening a new dynamics, and announce that matter, when made up into golf balls, obeys laws of an entirely different character from those governing its action when in any other condition.

If we could send off the ball from the club, as we might from a catapult, without spin, its behaviour would be regular, but uninteresting; in the absence of wind its path would keep in a vertical plane; it would not deviate

FIG. 1.

either to the right or to the left, and would fall to the ground after a comparatively short carry.

But a golf ball when it leaves the club is only in rare cases devoid of spin, and it is spin which gives the interest, variety, and vivacity to the flight of the ball. It is spin which accounts for the behaviour of a sliced or pulled ball, it is spin which makes the ball soar or "douk," or execute those wild flourishes which give the impression that the ball is endowed with an artistic temperament, and performs these eccentricities as an acrobat might throw in an extra somersault or two for the fun of the thing. This view, however, gives an entirely wrong impression of the temperament of a golf ball, which is, in reality, the most prosaic of things, knowing while in the air only one rule of conduct, which it obeys with unintelligent conscientiousness, that of always following its nose. This rule is the key to the behaviour of all balls when in the air, whether they are golf balls, base balls, cricket balls, or tennis balls. Let us, before entering into the reason for this rule, trace out some of its consequences. By the nose of the ball we mean the point on the ball furthest in front. Thus if, as in Fig. 1, C the centre of the ball is moving horizontally to the right, A will be the nose of the ball; if it is moving horizontally to the left, B will

[1] Discourse delivered at the Royal Institution on Friday, March 18, by Sir J. J. Thomson, F.R.S.

be the nose. If it is moving in an inclined direction CP, as in Fig. 2, then A will be the nose.

Now let the ball have a spin on it about a horizontal axis, and suppose the ball is travelling horizontally as in Fig. 3, and that the direction of the spin is as in the

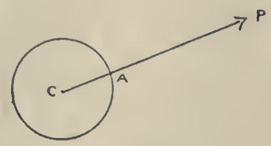


FIG. 2.

figure, then the nose A of the ball is moving upwards, and since by our rule the ball tries to follow its nose, the ball will rise and the path of the ball will be curved as in the dotted line. If the spin on the ball, still about a horizontal axis, were in the opposite direction, as in

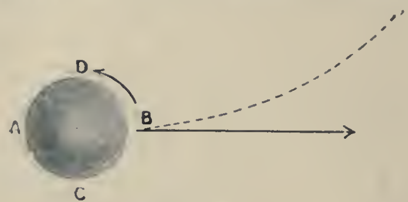


FIG. 3.

Fig. 4, then the nose A of the ball would be moving downwards, and as the ball tries to follow its nose it will duck downwards, and its path will be like the dotted line in Fig. 4.

Let us now suppose that the ball is spinning about a

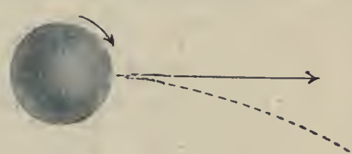


FIG. 4.

vertical axis, then if the spin is as in Fig. 5, as we look along the direction of the flight of the ball the nose is moving to the right; hence by our rule the ball will move off to the right, and its path will resemble the dotted line in Fig. 5; in fact, the ball will behave like a sliced ball.

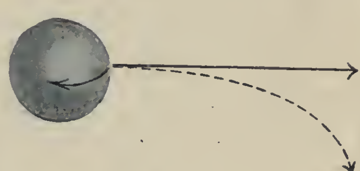


FIG. 5.

Such a ball, as a matter of fact, has spin of this kind about a vertical axis.

If the ball spins about a vertical axis in the opposite direction, as in Fig. 6, then, looking along the line of flight, the nose is moving to the left, hence the ball moves

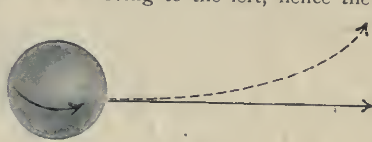


FIG. 6.

off to the left, describing the path indicated by the dotted line; this is the spin possessed by a "pulled" ball.

If the ball were spinning about an axis along the line of flight, the axis of spin would pass through the nose of the ball, and the spin would not affect the motion of the nose; the ball, following its nose, would thus move on without deviation.

Thus, if a cricket ball were spinning about an axis parallel to the line joining the wickets, it would not swerve in the air; it would, however, break in one way or the other after striking the ground; if, on the other hand, the ball were spinning about a vertical axis, it would swerve while in the air, but would not break on hitting the ground. If the ball were spinning about an axis intermediate between these directions it would both swerve and break.

Excellent examples of the effect of spin on the flight of a ball in the air are afforded in the game of base ball; an expert pitcher, by putting on the appropriate spins, can make the ball curve either to the right or to the left, upwards or downwards; for the sideway curves the spin must be about a vertical axis, for the upward or downward ones about a horizontal axis.

A lawn-tennis player avails himself of the effect of spin when he puts "top spin" on his drives, *i.e.* hits the ball on the top so as to make it spin about a horizontal axis, the nose of the ball travelling downwards, as in Fig. 4; this makes the ball fall more quickly than it otherwise would, and thus tends to prevent it going out of the court.

Before proceeding to the explanation of this effect of spin, I will show some experiments which illustrate the point we are considering. As the forces acting on the ball depend on the *relative* motion of the ball and the air, they will not be altered by superposing the same velocity on the air and the ball; thus, suppose the ball is rushing forward through the air with the velocity V, the forces will be the same if we superpose on both air and ball a velocity equal and opposite to that of the ball; the effect of this is to reduce the centre of the ball to rest, but to

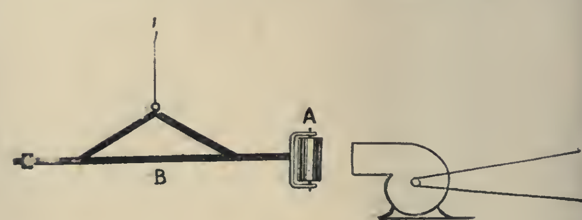


FIG. 7.

make the air rush past the ball as a wind moving with the velocity V. Thus the forces are the same when the ball is moving and the air at rest, or when the ball is at rest and the air moving. In lecture experiments it is not convenient to have the ball flying about the room; it is much more convenient to keep the ball still and make the air move.

The first experiment I shall try is one made by Magnus in 1852; its object is to show that a rotating body moving relatively to the air is acted on by a force in the direction in which the nose of the body is moving relatively to its centre; the direction of this force is thus at right angles both to the direction in which the centre of the body is moving and also to the axis about which the body is spinning. For this purpose a cylinder A (Fig. 7) is mounted on bearings so that it can be spun rapidly about a vertical axis; the cylinder is attached to one end of the beam B, which is weighted at the other end, so that when the beam is suspended by a wire it takes up a horizontal position. The beam yields readily to any horizontal force, so that if the cylinder is acted on by such a force this will be indicated by the motion of the beam. In front of the cylinder there is a pipe. D, through which a rotating fan driven by an electric motor sends a blast of air which can be directed against the cylinder. I adjust the beam and the beam carrying the cylinder so that the blast of air strikes the cylinder symmetrically; in this case, when the cylinder is not rotating the impact against it of the stream of air does not give rise to any motion of the beam. I now spin the cylinder, and you see that when the blast strikes against it the beam moves off sideways. It goes off one way when the spin is in one direction, and in the opposite way when the direction of spin is reversed.

The beam, as you will see, rotates in the same direction as the cylinder, which an inspection of Fig 8 will show you is just what it would do if the cylinder were acted upon by a force in the direction in which its nose (which, in this case, is the point on the cylinder first struck by the blast) is moving. If I stop the blast the beam does not move, even though I spin the cylinder, nor does it move when the blast is in action if the rotation of the cylinder is stopped; thus both spin of the cylinder and

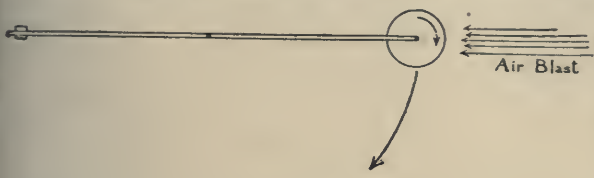


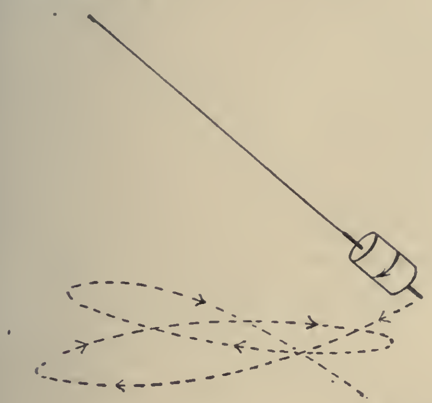
FIG. 8.

movement of it through the air are required to develop the force on the cylinder.

Another way of showing the existence of this force is to take a pendulum the bob of which is a cylinder, or some other symmetrical body, mounted so that it can be set in rapid rotation about a vertical axis. When the bob of the pendulum is not spinning the pendulum keeps swinging in one plane, but when the bob is set spinning the plane in which the pendulum swings no longer remains stationary, but rotates slowly in the same sense as the bob is spinning (Fig. 9).

and the other having the ordinary bramble markings, are mounted on an axis, and can be set in rapid rotation by an electric motor. An air-blast produced by a fan comes through the pipe B, and can be directed against the balls; the instrument is provided with an arrangement by which the supports of the axis carrying the balls can be raised or lowered so as to bring either the smooth or the bramble-marked ball opposite to the blast. The pressure is measured in the following way:—LM are two tubes connected with the pressure-gauge PQ; L and M are placed so that the golf balls can just fit in between them; if the pressure of the air on the side M of the balls is greater than that of the side L, the liquid on the right-hand side Q of the pressure-gauge will be depressed; if, on the other hand, the pressure at L is greater than that at M, the left-hand side P of the gauge will be depressed.

I first show that when the golf balls are not rotating there is no difference in the pressure on the two sides when the blast is directed against the balls; you see there is no motion of the liquid in the gauge. Next I stop the blast and make the golf balls rotate; again there is no motion in the gauge. Now when the golf balls are spinning in the direction indicated in Fig. 11 I turn on the blast, the liquid falls on the side Q of the gauge, rises on the other side. Now I reverse the direction of rotation of the balls, and you see the motion of the liquid in the gauge is reversed, indicating that the high pressure has gone from one side to the other. You see that the pressure is higher on the side M, where the spin carries this side of the ball into the blast, than on L, where the spin tends to carry the ball away from the blast. If we could



F G. 9.

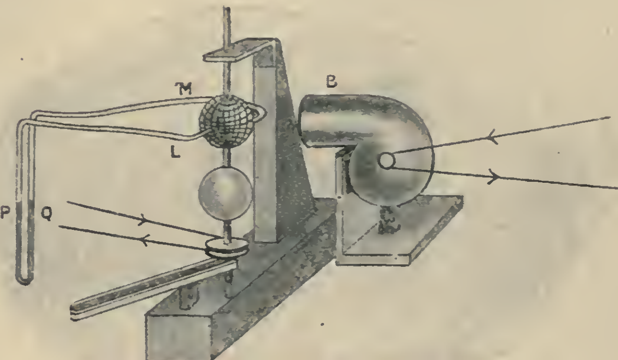


FIG. 11.

We shall now pass on to the consideration of how these forces arise. They arise because when a rotating body is moving through the air the pressure of the air on one side of the body is not the same as that on the other; the pressures on the two sides do not balance, and thus the body is pushed away from the side where the pressure is greatest.

Thus, when a golf ball is moving through the air, spinning in the direction shown in Fig. 10, the pressure

FIG. 10.

on the side ABC, where the velocity due to the spin conspires with that of translation, is greater than that on the side ADB, where the velocity due to the spin is in the opposite direction to that due to the translatory motion of the ball through the air.

I will now try to show you an experiment which proves that this is the case, and also that the difference between the pressure on the two sides of the golf ball depends upon the roughness of the ball.

In this instrument, Fig. 11, two golf balls, one smooth

imagine ourselves on the golf ball, the wind would be stronger on the side M than on L, and it is on the side of the strong wind that the pressure is greatest. The case when the ball is still and the air moving from right to left is the same from the dynamical point of view as when the air is still and the ball moves from left to right; hence we see that the pressure is greatest on the side where the spin makes the velocity through the air greater than it would be without spin.

Thus, if the golf ball is moving as in Fig. 12, the spin increases the pressure on the right of the ball and diminishes the pressure on the left.

To show the difference between the smooth ball and the rough one, I bring the smooth ball opposite the blast; you observe the difference between the levels of the liquid in the two arms of the gauge. I now move the rough ball into the place previously occupied by the smooth one, and you see that the difference of the levels is more than doubled, showing that with the same spin and speed of air blast the difference of pressure for the rough ball is more than twice that for the smooth.

We must now go on to consider why the pressure of the air on the two sides of the rotating ball should be different. The gist of the explanation was given by Newton nearly 250 years ago. Writing to Oldenburg in 1671 about the dispersion of light, he says, in the course of his letter:—"I remembered that I had often seen a tennis ball struck with an oblique racket describe such a curved line. For

a circular as well as progressive motion being communicated to it by that stroke, its parts on that side where the motions conspire must press and beat the contiguous air more violently, and there excite a reluctancy and reaction of the air proportionately greater." This letter has more than a scientific interest—it shows that Newton set an excellent precedent to succeeding mathematicians and physicists by taking an interest in games. The same explanation was given by Magnus, and the mathematical theory of the effect is given by Lord Rayleigh in his paper on "The Irregular Flight of a Tennis Ball," published in the *Messenger of Mathematics*, vol. vi., p. 14, 1877. Lord Rayleigh shows that the force on the ball resulting from this pressure difference is at right angles to the direction of motion of the ball, and also to the axis of spin, and that the magnitude of the force is proportional to the velocity of the ball multiplied by the velocity of spin, multiplied by the sine of the angle between the direction of motion of the ball and the axis of spin. The analytical investigation of the effects which a force of this type would produce on the movement of a golf ball has been discussed very fully by Prof. Tait, who also made a very interesting series of experiments on the velocities and spin of golf balls when driven from the tee, and the resistance they experience when moving through the air.

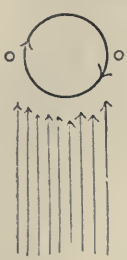


FIG. 12.

As I am afraid I cannot assume that all my hearers are expert mathematicians, I must endeavour to give a general explanation, without using symbols, of how this difference of pressure is established.

Let us consider a golf ball (Fig. 13) rotating in a current of air flowing past it. The air on the lower side of the ball will have its motion checked by the rotation of the ball, and will thus in the neighbourhood of the ball move more slowly than it would do if there were no golf ball present, or than it would do if the golf ball were there but was not spinning. Thus if we consider a stream of air flowing along the channel PQ, its velocity when near the ball at Q must be less than its velocity when it started at P; there must, then, have been pressure acting against the motion of the air as it moved from P to Q, *i.e.* the pressure of the air at Q must be greater than at a place like P, which is some distance from the ball. Now let us consider the other side of the ball; here the spin tends to carry the ball in the direction of the blast of air; if the velocity of the surface of the ball is greater than that of the blast, the ball will increase the velocity of the blast on this side, and if the velocity of the ball is less than that of the blast, though it will diminish the velocity of the air, it will not do so to so great an extent as on the other side of the ball. Thus the increase in pressure of the air at the top of the ball over that at P, if it exists at all, will be less than the increase in pressure at the bottom of the ball. Thus the pressure at the bottom of the ball will be greater than that at the top, so that the ball will be acted on by a force tending to make it move upwards.

side of the boat they have to face the wind, on the other side they have the wind at their backs. Now when they face the wind, the pressure of the wind against them is greater than if they were at rest, and this increased pressure is exerted in all directions, and so acts against the part of the ship adjacent to the deck; when they are moving with their backs to the wind the pressure against their backs is not so great as when they were still, so the pressure acting against this side of the ship will not be so great. Thus the rotation of the passengers will increase the pressure on the side of the ship when they are facing the wind and diminish it on the other side. This case is quite analogous to that of the golf ball.

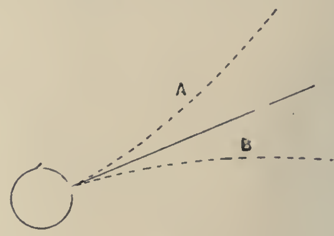


FIG. 14.

The difference between the pressures on the two sides of the golf ball is proportional to the velocity of the ball multiplied by the velocity of the spin. As the spin imparted to the ball by a club with a given loft is proportional to the velocity with which the ball leaves the club, the difference of pressure when the ball starts is proportional to the square of its initial velocity. The difference between the average pressures on the two sides of the ball need only be about one-fifth of 1 per cent. of the atmospheric pressure to produce a force on the ball greater than its weight. The ball leaves the club in a good drive with a velocity sufficient to produce far greater pressures than this. The consequence is that when the ball starts from the tee spinning in the direction shown in Fig. 14, this is often called underspin; the upward force due to the spin is greater than its weight, thus the resultant force is upwards, and the ball is repelled from the earth instead of being attracted to it. The consequence is that the path of the ball curves upward as in the curve A instead of downwards as in B, which would be its path if it had no spin. The spinning golf ball is, in fact, a very efficient heavier-than-air flying machine; the lifting force may be many times the weight of the ball.

The path of the golf ball takes very many interesting forms as the amount of spin changes. We can trace all these changes in the arrangement which I have here, and which I might call an electric golf links. With this apparatus I can subject small particles to forces of exactly the same type as those which act on a spinning golf ball.

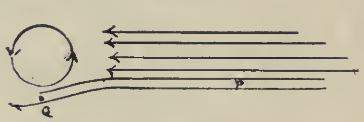


FIG. 13.

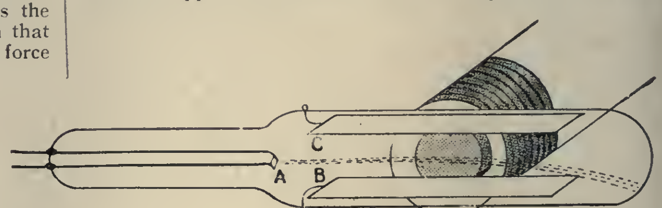


FIG. 15.

We have supposed here that the golf ball is at rest, and the air rushing past it from right to left; the forces are just the same as if the air were at rest, and the golf ball rushing through it from left to right. As in Fig. 13, such a ball rotating in the direction shown in the figure will move upwards, *i.e.* it will follow its nose.

It may perhaps make the explanation of this difference of pressure easier if we take a somewhat commonplace example of a similar effect. Instead of a golf ball, let us consider the case of an Atlantic liner, and, to imitate the rotation of the ball, let us suppose that the passengers are taking their morning walk on the promenade deck, all circulating round the same way. When they are on one

These particles start from what may be called the tee A (Fig. 15). This is a red-hot piece of platinum with a spot of barium oxide upon it; the platinum is connected with an electric battery which causes negatively electrified particles to fly off the barium and travel down the glass tube in which the platinum strip is contained; nearly all the air has been exhausted from this tube. These particles are luminous, so that the path they take is very easily observed. We have now got our golf balls off from the tee; we must now introduce a vertical force to act upon them to correspond to the force of gravity on the golf ball. This is easily done by the horizontal plates BC, which are electrified by connecting them with an electric

battery; the upper one is electrified negatively, hence when one of these particles moves between the plates it is exposed to a constant downwards force, quite analogous to the weight of the ball. You see now when the particles pass between the plates their path has the shape shown in Fig. 16; this is the path of a ball without spin. I can imitate the effect of spin by exposing the particles while they are moving to magnetic force, for the theory of these particles shows that when a magnetic force acts upon them it produces a mechanical force which is at right angles

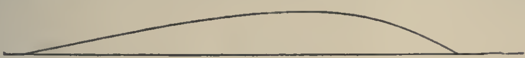


FIG. 16.

to the direction of motion of the particles, at right angles also to the magnetic force, and proportional to the product of the velocity of the particles, the magnetic force, and the sine of the angle between them. We have seen that the force acting on the golf ball is at right angles to the direction in which it is moving at right angles to the axis of spin, and proportional to the product of the velocity of the ball, the velocity of spin, and the sine of

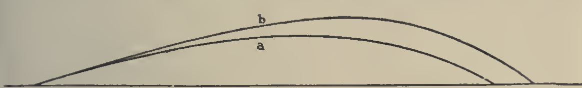


FIG. 17.

the angle between the velocity and the axis of spin. Comparing these statements, you will see that the force on the particle is of the same type as that on the golf ball if the direction of the magnetic force is along the axis of spin and the magnitude of the force proportional to the velocity of spin, and thus if we watch the behaviour of these particles when under the magnetic force we shall get an indication of the behaviour of the spinning golf

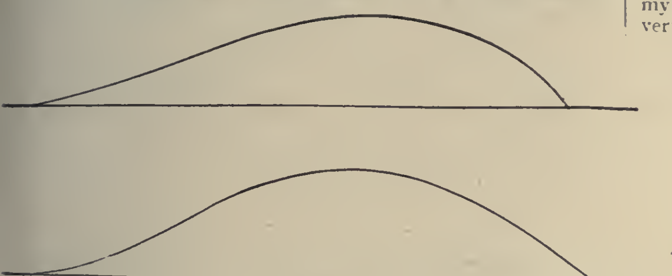


FIG. 18.

ball. Let us first consider the effect of underspin on the flight of the ball; in this case the ball is spinning, as in Fig. 3, about a horizontal axis at right angles to the direction of flight. To imitate this spin I must apply a horizontal magnetic force at right angles to the direction

FIG. 19.

of flight of the particles. I can do this by means of the electromagnet. I will begin with a weak magnetic force, representing a small spin. You see how the path differs from the one when there was no magnetic force; the path, to begin with, is flatter, though still concave, and the carry is greater than before—see Fig. 17, *a*. I now increase the strength of the magnetic field, and you will see that the carry is still further increased, Fig. 17, *b*. I increase the spin still further, and the initial path becomes convex instead of concave, with a still further increase in carry, Fig. 18. Increasing the force still more, you see the particle soars to a great height, then comes suddenly down, the carry now being less than in the previous case (Fig. 19). This is still a familiar type of the path of the golf ball. I now increase the magnetic force still further, and now we get a type of flight not to my knowledge ever observed in a golf ball, but which would be produced if we could put on more spin than

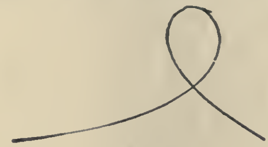


FIG. 20.

we are able to do at present. You see there is a kink in the curve, and at one part of the path the particle is actually travelling backwards (Fig. 20). Increasing the magnetic force I get more kinks, and we have a type of drive which we have to leave to future generations of golfers to realise (Fig 21).

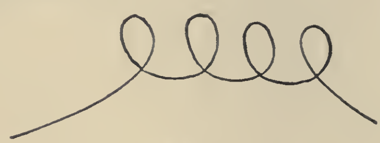


FIG. 21.

By increasing the strength of the magnetic field I can make the curvature so great that the particles fly back behind the tee, as in Fig. 22.

So far I have been considering underspin. Let us now illustrate slicing and pulling; in these cases the ball is spinning about a vertical axis. I must therefore move my electromagnet, and place it so that it produces a vertical magnetic force (Fig. 23). I make the force act

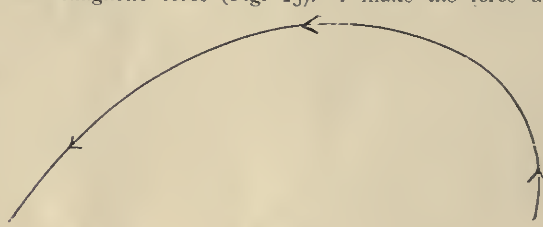


FIG. 22.

one way, say downwards, and you see the particles curve away to the right, behaving like a sliced ball. I reverse the direction of the force and make it act upwards, and the particles curve away to the left, just like a pulled ball.

By increasing the magnetic force we can get slices and

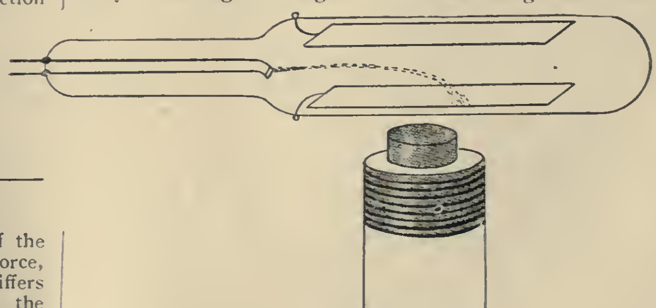


FIG. 23.

pulls much more exuberant than even the worst we perpetrate on the links.

Though the kinks shown in Fig. 20 have never, so far as I am aware, been observed on a golf links, it is quite easy to produce them if we use very light balls. I have

here a ball A made of very thin indiarubber of the kind used for toy balloons, filled with air, and weighing very little more than the air it displaces; on striking this with the hand, so as to put underspin upon it, you see that it describes a loop, as in Fig. 24.

Striking the ball so as to make it spin about a vertical axis, you see that it moves off with a most exaggerated slice when its nose is moving to the right looking at it from the tee, and with an equally pronounced pull when its nose is moving to the left.

One very familiar property of slicing and pulling is that the curvature due to them becomes much more pronounced when the velocity of the ball has been reduced than it was at the beginning when the velocity was greatest. We can easily understand why this should be so if we consider the effect on the sideways motion of reducing the velocity to one half. Suppose a ball is pro-

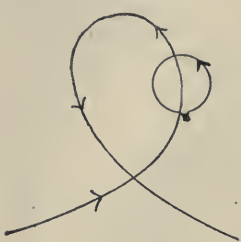


FIG. 24.

FIG. 25.

jected from A in the direction AB, but is sliced; let us find the sideways motion BC due to slice. The sideways force is, as we have seen, proportional to the product of the velocity of the ball and the velocity of spin, or, if we keep the spin the same in the two cases, to the velocity of the ball; hence, if we halve the velocity we halve the sideways force, hence, in the same time, the displacement would be halved too, but when the velocity is halved the time taken for the ball to pass from A to B is doubled. Now the displacement produced by a constant force is proportional to the square of the time; hence, if the force had remained constant, the sideways deflection BC would have been increased four times by halving the velocity, but as halving the velocity halves the force, BC is doubled when the velocity is halved; thus the sideways movement is twice as great when the velocity is halved.

If the velocity of the spin diminished as rapidly as that of translation, the curvature would not increase as the velocity diminished, but the resistance of the air has more effect on the speed of the ball than on its spin, so that the speed falls the more rapidly of the two.

The general effect of wind upon the motion of a spinning ball can easily be deduced from the principles we discussed in the earlier part of the lecture. Take, first, the case of a head-wind. This wind increases the relative velocity of the ball with respect to the air; since the force due to the spin is proportional to this velocity, the wind

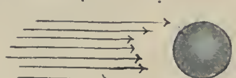


FIG. 26.

increases this force, so that the effects due to spin are more pronounced when there is a head-wind than on a calm day. All golfers must have had only too many opportunities of noticing this. Another illustration is found in cricket; many bowlers are able to swerve when bowling against the wind who cannot do so to any considerable extent on a calm day.

Let us now consider the effect of a cross-wind. Suppose the wind is blowing from left to right, then, if the ball is pulled, it will be rotating in the direction shown in Fig. 26; the rules we found for the effect of rotation on the difference of pressure on the two sides of a ball in a blast of air show that in this case the pressure on the front half of the ball will be greater than that on the rear half, and thus tend to stop the flight of the ball. If, however, the spin was that for a slice, the pressure on the rear half would be greater than the pressure in front, so that the difference in pressure would tend to push on the ball and make it travel further than it otherwise would. The moral of this is that if the wind is coming from the left we should play up into the wind and slice the ball, while if it is coming from the right we should play up into it and pull the ball.

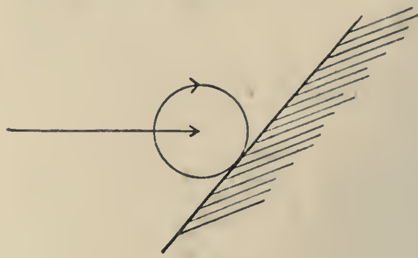


FIG. 27.

I have not time for more than a few words as to how the ball acquires the spin from the club. But if you grasp the principle that the action between the club and the ball depends only on their *relative* motion, and that it is the same whether we have the ball fixed and move the club or have the club fixed and project the ball against it, the main features are very easily understood.

Suppose Fig. 27 represents the section of the head of a

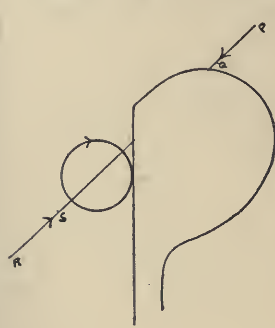


FIG. 28.

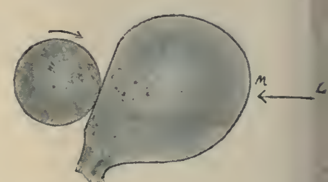


FIG. 29.

lofted club moving horizontally forward from right to left, the effect of the impact will be the same as if the club were at rest and the ball were shot against it horizontally from left to right. Evidently, however, in this case the ball would tend to roll up the face, and would thus get spin about a horizontal axis in the direction shown in the figure; this is underspin, and produces the upward force which tends to increase the carry of the ball.

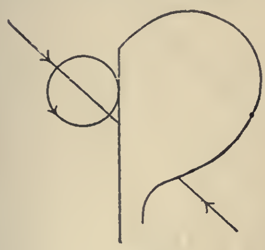


FIG. 30.

FIG. 31.

Suppose, now, the face of the club is not square to its direction of motion, but that, looking down on the club, its line of motion when it strikes the ball is along PQ (Fig. 28), such a motion as would be produced if the arms were pulled in at the end of the stroke, the effect of the impact now will be the same as if the club were at rest and the ball projected along RS, the ball will endeavour to roll along the face away from the striker; it will spin

in the direction shown in the figure about a vertical axis. This, as we have seen, is the spin which produces a slice. The same spin would be produced if the motion of the club was along LM and the face turned so as to be in the position shown in Fig. 29, *i.e.* with the heel in front of the toe.

If the motion and position of the club were as in Figs. 30 and 31, instead of as in Figs. 28 and 29, the same consideration would show that the spin would be that possessed by a pulled ball.

THE SECOND FRENCH ANTARCTIC EXPEDITION.[1]

THE Antarctic is so vast as to admit of many expeditions working together with good results, and Dr. Charcot therefore resolved to return to the region which he had explored to some extent in 1903–5. His precise object was to investigate from every point of view as great an extent of the Antarctic as possible, without any considerations as to latitude. He desired to enter the region where the ice drifted furthest to the north, and he had no hope whatever of reaching the Pole. He had a three-masted vessel constructed at St. Malo, with auxiliary engine, which he named *Le Pourquoi Pas?* It was equipped with every care, and supplied with the most modern instruments for observation. The crew consisted of twenty-two men, most of whom had already accompanied Dr. Charcot on his previous expedition. The staff consisted of seven, who were experts in different departments of science. The expedition started from Havre on August 15, 1909, and on December 16 left Punta Arenas for the Antarctic.

After passing Deception Island Dr. Charcot made for Port Lockroy, in Gerlache Strait, where the work of the expedition began. Some days later the expedition arrived at Wandell, which was found to be a very unsatisfactory harbour, and therefore the expedition moved on to Petermann Island. Dr. Charcot with two of his companions set out to discover if it was possible to pass between the Biscoe Islands and the coast. As they expected to return the same day they did not take any provisions or change of garments. Their return was blocked by the ice, and it was four days before they were able to reach the ship, narrowly escaping death from hunger and cold. From Petermann Island a journey was made towards the south along the coast, the mapping of which, begun during the previous expedition, was completed. A hydrographical survey was made of Adelaide Island, which was found to be seventy miles long instead of eight, as had previously been stated. To the south of Adelaide, in a region which had not previously been visited, a great gulf was discovered which was entitled Marguerite Bay. Here the greatest difficulties were met with from the ice and from icebergs, but these were successfully overcome. In spite of all the difficulties the expedition discovered and studied the hydrography of 120 miles of unknown coast to the south.

At last, after two attempts, the expedition succeeded in traversing the ice and reaching Alexander Land, which was mapped, and the hydrography of which was investigated. It was found absolutely impossible to winter here, however, and the expedition was compelled to return to Petermann Island. Observations, however, were carried on with great perseverance, numerous soundings and dredgings were made, and many photographs taken. The house which had been constructed here on the previous expedition was still available, and after three days' work was put into condition for being able to be used during the winter. In the autumn numerous and long excursions were made on the glaciers. The winter, though mild, was almost continuously stormy, a formidable north-east wind blowing during nine months. An immense quantity of snow fell. The terrible season was very trying to the members of the expedition, some of whom had been attacked with scurvy.

An attempt was made to traverse Graham Land. The members of the expedition who carried out the work returned with many interesting observations, but without having been able to overcome the impassable perpendicular wall of granite and of ice which lines the whole of the coast where a landing was attempted to be made. Many other excursions were made in the neighbourhood. With great difficulty, owing to the state of the ice, Deception Island was reached at the end of November, and the expedition received the greatest hospitality from the whalers who are settled on the island. Many observations were here made in seismography, on the tides, on hydrography, in natural history and geology, and many soundings and dredgings were carried out.

After the expedition had been refitted it visited Bridgman Island, Admiralty Bay, the south coast of the South Shetlands, at all of which places good work was done. After this another attempt was made to penetrate southwards. In spite of the unfavourable condition of the ice and the weather, the expedition succeeded in passing beyond all the latitudes previously reached to the southwest of Alexander Land. It was hoped that the expedition would be able to make further discoveries to the south and the west of Alexander Land, but the formidable condition of the pack rendered this extremely difficult. The route, however, was continued along the edge of the pack, when Peter 1st Island was discovered in the place at which it is usually charted. After this the icebergs became so numerous as to be embarrassing and dangerous. Dr. Charcot reckons that they counted something like 5000 of these in one day. However, they succeeded in reaching 126 degrees west longitude, and so reached two or three degrees further south than the route followed by Cook and Bellingshausen. As the supply of coal was now almost exhausted, and the health of the expedition had become alarming, it was decided to make for the north. The icebergs gradually diminished, and at last disappeared, and, thanks to an uninterrupted series of strong winds, varying from south-west to N.N.W., rapid progress was made. In ten days the Straits of Magellan were reached, and on February 12 the expedition anchored at Punta Arenas. The *Pourquoi Pas?* behaved admirably in spite of the many trials to which it was subjected, and the crew was all that could be desired, while the scientific staff worked incessantly, and from the scientific point of view the programme was scrupulously carried out. It will take many months to work out the observations which have been made during the expedition, to study and arrange the rich collections obtained, and therefore it is somewhat difficult to give more than a brief *résumé* of the results obtained.

From the geographical point of view the expedition has proved that the west coast of what may be called the South American Antarctic is cut up by deep fjords, and the coast studded with islands and reefs. Graham Land is continued to the south by a land to which Dr. Charcot has given the name Terre Loubet; this is continued by the Terre Fallières. Alexander Land, which has only been seen by Bellingshausen, is a large island, but the lands discovered by the expedition to the south and west of that very probably join on Terre Fallières. Outside of Peter 1st Island the expedition did not obtain sight of any other land, but their soundings in continuation of those of the Belgian expedition, the configuration of the icebergs and their movements, seem to indicate that there exists a continual line, which most probably joints the Graham Land section of the Antarctic to King Edward VII. Land. Dr. Charcot considers that the further exploration of this land is very desirable, although the difficulties from the state of the weather and the formidable nature of the ice here will render such an enterprise extremely difficult.

In spite of the difficulties which had to be faced, the observations made in the various departments of science are extremely rich. Careful mapping of the lands visited was carried out throughout; numerous gravity observations were made; earthquake phenomena recorded; an eclipse of the sun on December 23, 1908, was observed; important geological observations carried out, proving that the same dioritic and granitic forms which are to be found in Graham Land are continued further to the south. Of the existence of a continental plateau there can be little doubt from the observations that were made. Numerous excursions were made on the glaciers into the interior: careful continuous meteorological observations were re-

[1] Summary of a paper by Dr. J. B. Charcot read before the Royal Geographical Society on December 19.

corded; 100 soundings were made; 200 specimens of the water collected; twenty dredgings were carried out; observations of interest in magnetism, in solar radiation, zoological and botanical collections, and additions to our knowledge in other directions, rendering the expedition from the scientific point of view completely successful.

COMPARISONS OF JURASSIC FLORAS.

At the forty-ninth annual meeting of the Yorkshire Naturalists' Union, held at Middlesbrough on Saturday, December 17, Prof. A. C. Seward, F.R.S., delivered his presidential address, entitled "The Jurassic Flora of the East of Yorkshire in Relation to the Jurassic Floras of the World." It was pointed out that the estuarine beds of east Yorkshire were among the most famous and important strata of the world from the point of view of their fossil contents. Since the publication in 1822 of Young and Bird's "Geological Survey of the Yorkshire Coast" much attention has been paid to the fossil plants of Yorkshire by British and foreign students. During the first half of the nineteenth century a considerable amount of work was done by such pioneers as William Bean, John Williamson, W. Crawford Williamson, John Phillips, and others. Prof. Seward gave a general sketch of the flora which the labours of Yorkshire naturalists have enabled students to investigate. Prof. Nathorst, of Stockholm, who has more than once invaded our shores, recently transported a portion of our island to his country. By establishing a department devoted to the floras of the past, the Swedish Academy has set an example which the trustees of our national collections would do well to imitate. Palæobotany is still without a representative in the British Museum!

Prof. Seward then reviewed the various fossil remains of Algæ and Fungi, Hepophyta, Equisetales, Lycopodiales, Filicales, Gymnospermæ, Ginkgoales, and Coniferales, being some of the types which occur in the Yorkshire strata. The Yorkshire coast flora is characterised by the abundance of ferns and cycads and certain types of conifers, though as yet it is not possible to make any statement as to the relative abundance of these different groups. It is also probable that the Ginkgoales played a fairly prominent part in the composition of the vegetation. The most interesting fact in regard to the Jurassic ferns is that they afford strong presumptive evidence in support of the view that their nearest living allies are to be sought in the southern hemisphere. As regards the cycads, comparison with recent genera is rendered more difficult because of the greater gulf between recent members of the group and those which flourished in the Jurassic era. There can, however, be no reasonable doubt that the cycads of to-day are derived from an ancient stock which produced also Williamsonia and other Jurassic genera. Here, again, the recent plants most nearly akin to those of the Mesozoic floras are chiefly characteristic of southern and warmer regions. The same general statement is applicable to the relation of some of the Jurassic conifers to recent types. Finally, in the genus Ginkgo of the Jurassic flora we have a member of a group which would probably have ceased to be represented among living plants were it not for the fact that the recent species has been long held in veneration in the Far East as a sacred tree. With these southern forms there grew in profusion stalwart Equisetums, which afforded one of the few instances of a genus still represented by several species in the British flora which can claim a Jurassic ancestry.

At first sight one might be tempted to infer that there is clear evidence of a tropical, or at least subtropical, climate in Jurassic Europe. This would, perhaps, be a correct conclusion, but it is one which cannot be confidently made, so far, at least, as the botanical evidence is concerned. The fact must be borne in mind that among living plants very closely allied types, or even one of the same species, may flourish under widely different climatic conditions, as in the case of our own familiar bracken fern, which appears to be equally at home on the Yorkshire moors, in Tasmania, Abyssinia, and elsewhere. The comparison of a past with a recent flora is bound up with numerous considerations in addition to those connected with the comparison of existing and extinct species. During the Rhætic and Jurassic eras, and in the succeeding Cretaceous and Tertiary epochs, the genus Ginkgo was very widely distributed in Europe. So recently as the Lower Tertiary period it existed in what is now the west of Scotland in a form hardly distinguishable from the maiden-hair tree. Are we justified in assuming that the living species is a safe criterion as regards power of resistance or capabilities of life with which the family was endowed at the zenith of its vigour? Were it possible to learn from the maiden-hair tree what vicissitudes its ancestors passed through since the days of the Jurassic period, we might hear of unequal competition and gradual migration from northern to southern latitudes.

In dealing with the relation of the Yorkshire Jurassic flora with that of other parts of the world, it is remarkable to find that almost precisely similar plants to those occurring in the local rocks also are found embedded in strata of about the same age at places so far distant as Bornholm, Poland, Turkestan, Siberia, Korea, Japan, Franz Josef Land, Spitsbergen, Greenland, America, India, and Australia. This extraordinary distribution would certainly seem to indicate that the climate in Jurassic times must have been much more uniform the world over than obtains to-day.

As a result of Prof. Seward's address and his interest in the union's work, a committee was formed for the investigation of the Jurassic plants of Yorkshire, with Prof. Seward as first chairman.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Sheffield.—Mr. R. J. Pye-Smith has resigned the professorship of surgery. The council has adopted the following resolution:—"That the resignation of Mr. Pye-Smith as professor of surgery in the University be accepted with great regret. Mr. Pye-Smith, who is the senior member of the teaching staff, has been a teacher of surgery for thirty-four years, first in the old Medical School, next in the University College, and finally in the University, and the council desire to place on record their appreciation of the distinguished services which he has rendered to the cause of medical education in Sheffield."

Dr. E. W. Adams has been appointed to the post of lecturer in materia medica and assistant to the professor of materia medica, pharmacology, and therapeutics.

Dr. W. Goodwin, head of the chemical department at the South-Eastern Agricultural College, Wye, has been appointed principal of the Midland Agricultural College, Kingston, Derbyshire.

A Reuter message from Chicago announces that Mr. John D. Rockefeller has made a final donation of 2,000,000*l.* to Chicago University, making a total of approximately 7,000,000*l.* given by him to that institution.

The annual meeting of the Geographical Association will be held on Saturday, January 14, 1911, in the Lecture Hall, London School of Economics. The following short papers will be read:—Geography at seven years, Miss C. von Wyss; map-making as a school subject, F. Beames; practical contouring round a London school, J. Fairgrieve; the training of teachers in geography, J. F. Unstead. An address will be delivered by the president, Mr. Douglas W. Freshfield, and a lecture on "The Highways of England and Wales, Past and Present, and their Relationship to Geographical Conditions," by Mr. G. Montagu.

Liverpool.—The Liverpool School of Tropical Medicine (Incorporated) at the time of the death of the late Dr. J. E. Dutton in the Congo Free State, whilst investigating sleeping sickness and other tropical diseases there, started a fund to establish a chair in the University in his memory. The necessary amount has now been raised, mainly through the generosity of the late Sir Alfred Jones, Mr. W. H. Lever, Sir William Hartley, and many others. The Liverpool School has at present a lectureship in tropical entomology, and the committee decided, therefore, that the best form the memorial could take would be the foundation in the University of a Dutton professorship in tropical entomology. The value of close investigation into

the habits and life-cycles of disease-bearing biting insects, not only in the tropics, but also at home, is daily becoming more evident. Dr. Dutton was one who realised this intensely, and it is fitting that his memorial should take the form of a chair of medical entomology. The appointment to the chair has not yet been made by the University, but will be announced in due course.

An agreement has been arrived at between the Senate of the Queen's University of Belfast and the Corporation of Belfast by which the work of the University and of the Belfast Municipal Technical Institute will be coordinated. As the Vice-Chancellor of the University said at the meeting of the Senate on December 15, when the agreement was made, this will afford an opportunity to young men in Belfast of obtaining a complete education in such subjects as mechanical engineering, electrical engineering, chemical technology, textile technology, and naval architecture, and of securing the degree of B.Sc. at the conclusion of their course of work. The advantages of this arrangement to the Technical Institute, on one hand, and to the University on the other, will be very great. By the proposed arrangement means will be provided for obtaining trained captains of industry for the various great enterprises for which Belfast is famous. The coordination forges another link between the University and the city. The technical subjects mentioned will be studied at the institute, which becomes an integral part of the University in a manner analogous to several cases in England. We learn, too, that a public textile testing and conditioning house has been started in connection with the institute at Belfast. The functions of the testing house are to be similar to those of other public textile testing and conditioning houses, namely, the examination of textile materials with the view of ascertaining and certifying their true weight, length, condition, and strength, and, in addition, the carrying out of such other tests and investigations as may be required in order that spinners, manufacturers, merchants, and others desirous of having tests conducted and an official certificate issued may effect their object through the medium of an independent public authority.

As the result of representations made by the Old Students Association of the Royal College of Science, London, of which Sir Thomas H. Holland, K.C.I.E., F.R.S., is president, the governing body of the Imperial College of Science and Technology has granted the privilege of wearing academic costume to associates of the Royal College of Science, London, a like privilege being also granted to associates of the Royal School of Mines, of the City and Guilds of London Institute, and to diplomate students of the Imperial College. Patterns for academic costume have been approved by the governing body. In each case the gown is as for the University of London B.A., of black silk or stuff, but with the forearm seam open, and without button, cord, or pleats. The hoods are differentiated for the several colleges as regards the colour of the neckband, which for A.R.C.S.'s will be white, for A.R.S.M.'s gold, for A.C.G.I.'s red (as in the Arms of the City of London), and black for diplomate students of the Imperial College, the hood in each case being as the Oxford University M.A. hood in size and shape, of black silk or stuff, partly lined with white watered silk to a depth of 6 inches, with an edging, 1 inch in width, of royal purple velvet, ½ inch from the outer edge, and with a neckband 1¼ inches in width, lined with white watered silk and edged with white watered silk ¼ inch in width. As regards the Associates of the Royal College of Science, the decision of the governing body removes a grievance of long standing, which was felt more especially by teachers in secondary and technical schools. It is generally recognised that the A.R.C.S. diploma represents a course of training in no sense inferior to that represented by a university degree and there is therefore no reason why an invidious distinction should be made between university graduates and associates of the college in respect of academic costume. The claim of associates to the privilege is strengthened by the fact that it has been granted to associates of various London colleges, such as the Royal College of Art, King's College, the Royal College of Organists, and the College of Preceptors. Several London firms of robe-makers have undertaken to supply academic costume of the approved patterns.

Sir Alfred Keogh, Rector of the Imperial College of Science and Technology, delivered an address at the Woolwich Polytechnic on Saturday, December 17, on the occasion of the nineteenth annual prize distribution. In the course of his remarks he said:—There are certain subjects engaging our attention at the present moment which are of enormous importance to the future of the country. We have been told that we are losing our supremacy because we do not keep science and industry in close touch with one another; we are told that the manufacturers have not an appreciation of science, and as a consequence are being ousted in various directions by other people. However it may shock you to hear me say so, I have the greatest sympathy with the manufacturers. As a matter of fact, I know in this country there are manufacturers who have the greatest appreciation for scientific education, and are employing foreigners in their workshops because they have the required knowledge. The reason is this, that we are not providing the class of men this country needs, and until we do provide them the manufacturer will turn aside and get people from abroad. We have been told all this, we have been told that our industries are failing in consequence, and an effort was made—which has been passed unnoticed—to bring science and industries together and to coordinate general scientific education in London. Three of the great colleges at South Kensington—the City and Guilds College, the Royal College of Science, and the Royal School of Mines—were combined for the purpose of coordinating knowledge, and that incident passed almost unnoticed. The Imperial College was intended to coordinate the whole scientific education in London, and we have in London (I include, of course, Woolwich) a number of polytechnic institutions doing technical work, and we are not coordinated one with the other. If something could be done to coordinate the polytechnics with the Imperial College, I for one have no fear of the foreigner. This I earnestly hope will come about soon. Perhaps it may be possible to get the teachers in the polytechnics of London to recognise that there is one great need at the present moment, that professors and teachers should come together and devise a scheme to work for one solid purpose and one object, and that is the correlation of science and industrial work. I do not know what the opinion here is on this point, but we think at the Imperial College that there should be a great imperial college in London including this institution, including every other polytechnic, in which we shall be able to give our own degrees. The principals of the polytechnics have been called upon to express their opinion. I earnestly hope that they will not forget that upon their shoulders will rest the responsibility of saying whether these young men who are here to-night are simply to become B.Sc.'s and then to be thrown aside, or whether they are to become learned Britons to help forward the industries of our Empire; unless the polytechnics do come forward with their solution of the difficulty, then I can only tell you that some other authority will have to start other institutions.

SOCIETIES AND ACADEMIES.

London.

Royal Society, December 8.—Mr. A. B. Kempe, treasurer and vice-president, in the chair.—Sir W. de W. **Abney**: Colour-blindness and the trichromatic theory of colour-vision. Part ii.: Incomplete red or green blindness. In this paper the author continues the subject of the trichromatic theory of colour-vision and colour-blindness. In part i. he treated of complete colour-blindness, and in this paper, part ii., he treats of incomplete colour-blindness. He shows how the amount of incompleteness can be accurately determined from the luminosity curve of a colour-blind person both red and green blind. He also shows that the amount of incompleteness can be determined from observations made by the red- or green-blind at any part of the spectrum if someone with normal vision makes observations at the same place, using unchanged white light for the comparison. Incidentally, he shows

that the three sensation components of the different colours of the spectrum, as determined by himself, are verified by the results, and that the trichromatic theory fully accounts for all cases of incomplete colour-blindness which he has measured.—Lord **Rayleigh**: The sensibility of the eye to variations of wave-length in the yellow region of the spectrum.—Sir D. **Bruce** and others: Trypanosome diseases of domestic animals in Uganda. IV.: *Trypanosoma uniforme*, sp. nov.—Sir D. **Bruce** and others: Trypanosome diseases of domestic animals in Uganda. V.: *Trypanosoma nanum* (Laveran).—Major Ronald **Ross** and D. **Thomson**: Some enumerative studies on malarial fever. The object of these researches was to make a minute coordinated study of cases of malarial infection occurring in the Tropical Ward of the Royal Southern Hospital at Liverpool. The first care of the authors was to elaborate a method by which the number of parasites could be correctly counted, and the one which they adopted was to make a measured quantity of blood into a dehæmoglobinised thick-film, and then to count the organisms contained in it. Almost daily estimates of the number of parasites, with frequent estimates of the leucocytes, the hæmoglobin, and the excreted urobilin, were made since the beginning of this year in twenty-four cases of *Plasmodium falciparum*, eight cases of *P. vivax*, and one case of *P. malariae* and *P. falciparum*. Correlation with minor deviations was found between the number of asexual parasites present and the degree of fever. If the asexual forms did not number more than several hundreds per cm. they were not numerous enough in these cases to produce fever. The asexual forms do not disappear between relapses, as usually thought, but tend to diminish. It is roughly estimated from these cases that quinine reduces the asexual forms by 50 to 80 per cent.—G. C. E. **Simpson**: Hæmoglobin metabolism in malarial fever. (Preliminary note.) In the pyrexia of malaria there is a marked fall in the hæmoglobin of the blood, and further investigation of this question was undertaken in the hope that it might throw light on the relationship of malaria and blackwater fever. In benign tertian malaria a slightly increased output of urinary urobilin occurs, in malignant tertian malaria a greater increase, and in the malignant form mrked urobilinuria was sometimes found.—Major Ronald **Ross** and D. **Thomson**: A case of sleeping sickness studied by precise enumerative methods; further observations. *Conclusions*.—(1) The increase of trypanosomes is due to their active multiplication, depending on the following conditions:—(*a*) the liberation of a reproductive stimulant from the dead trypanosomes of the previous fall; (*b*) the small number of leucocytes, especially mononuclears; (*c*) the habituation of the trypanosomes to their antibodies; (*d*) the absence or diminution of antibodies. (2) The decrease of trypanosomes is due to their rapid death, and to a cessation of multiplication depending on the following conditions:—(*a*) the large increase of leucocytes, especially of mononuclears; (*b*) the formation of antibodies in the serum. (3) The trypanosomes remaining between the rises are resistent forms. (4) Extracts of dead cells would appear to stimulate the corresponding live cells to multiply or divide.—Dr. H. B. **Fantham** and J. G. **Thomson**: Enumerative studies on *Trypanosoma gambiense* and *Trypanosoma rhodesiense* in rats, guinea-pigs, and rabbits; periodic variations disclosed. (1) The strains of trypanosomes used in these investigations were:—(*a*) *T. gambiense*, old laboratory strain; (*b*) *T. rhodesiense* (Stephens and Fantham), from a patient suffering from sleeping sickness in Rhodesia. (2) Rats, guinea-pigs, and rabbits were inoculated with a definite number of trypanosomes, and daily counts were made of the parasites in the peripheral blood of the animals. (3) Periodic variation was found in all these animals comparable to that discovered by R. Ross and D. Thomson in the blood of the sleeping sickness patient. (4) Rats inoculated with each strain showed either a periodic increase or a continuous rise in the numbers of parasites. (5) The average life of rats inoculated with *T. rhodesiense* was 11·3 days, with *T. gambiense* 13·8 days. (6) The average incubation period in rats in the case of *T. rhodesiense* was 2·9 days, in *T. gambiense* 4·4 days. The average weights of the animals and the average number of parasites inoculated were approximately the same in the two strains. (7) In rats infected with *T. rhodesiense* the period between the crests of the graph was 3 to 4 days, while in *T. gambiense* this period was 4 to 6 days. (8) In guinea-pigs the trypanosomiasis tended to run a chronic course, but the life of animals infected with *T. rhodesiense* was shorter. The period between the crests of the graph in both strains was longer than in rats, namely, 5 to 8 days. (9) Rabbits inoculated with *T. rhodesiense* also exhibit periodic variation. (10) The periodicity is explained by (*a*) variations in resistance on the part of the host, accompanied by (*b*) the formation of latent bodies by the trypanosomes in the internal organs of the host during fall in numbers of the parasites in the peripheral blood.—Dr. H. B. **Fantham**: The life-history of *Trypanosoma gambiense* and *Trypanosoma rhodesiense* as seen in rats and guinea-pigs. (1) The researches were undertaken to investigate the parasitological aspect of the numerical cyclical development found by R. Ross and D. Thomson in the trypanosome of a patient suffering from sleeping sickness contracted in Rhodesia. Rats and guinea-pigs inoculated with *T. rhodesiense* and with *T. gambiense* were killed at various stages of infection and their internal organs examined, controls being used. (2) The formation of a non-flagellate, latent or rounded body from a trypanosome was observed in life, much of the cytoplasm and the flagellum of the flagellate being cast off. (3) Non-flagellate bodies were seen to grow into flagellate trypanosomes when placed in fresh, warm, uninfected blood. (4) The latent or non-flagellate stages are formed at or near the time when the trypanosomes are most numerous in the peripheral blood. (5) The latent bodies are relatively numerous in the internal organs when the flagellates are few in the peripheral blood of the host. (6) The formation of latent bodies takes place especially in the lungs. The latent bodies collect in the spleen and bone-marrow, as stated by Salvin-Moore and Breinl. (7) Latent bodies from the spleen of an infected rat inoculated into another rat produced trypanosomiasis. (8) The latent bodies are the post-flagellate stages of one generation of trypanosomes and the pre-flagellate stages of the succeeding generation. (9) There is a life-cycle of *T. gambiense* and of *T. rhodesiense* in vertebrate hosts. (Compare Crithidia and Herpetomonas in invertebrates.) (10) The occurrence of latent bodies explains the recurrence of trypanosomiasis in hosts when it has apparently died out. (11) Mutual action and reaction of the host and the parasite lead to the formation of rounded bodies, which are relatively resistant. (12) Some flagellate trypanosomes do not form latent bodies, but degenerate. Some latent bodies die, and do not flagellate.—Major R. **Ross** and J. G. **Thomson**: Experiments on the treatment of animals infected with trypanosomes by means of atoxyl, vaccines, cold, X-rays, and leucocytic extract; enumerative methods employed. In all the animals used in these experiments regular daily counts were made of the parasites in the peripheral blood by means of thick-film method. (1) Small repeated doses of atoxyl prolonged the lives of rats infected with the Rhodesian strain of trypanosomes, but failed to have any trypanocidal action, as was demonstrated by the fact that the parasites increased rapidly and showed very active division. (2) We venture to suggest that small doses of atoxyl actually stimulated the trypanosomes of this strain to divide, and that the drug is also a tonic to the body cells of the host. (3) Large doses of atoxyl are trypanocidal, but the parasites form resistant bodies, and cure is only temporary. The dose required to approach as near lethal as possible, and even then a cure was not obtained in the Rhodesian strain. (4) Vaccine treatment gave indefinite results, and insufficient experiments prevent definite conclusions being formed. The life of one rat seemed to be prolonged when the vaccine was administered in doses of 10,000,000 trypanosomes, with an interval between the doses. We suggest that the time of administration, the amount given, and the interval between the doses are all of importance, and further work is being carried out. (5) Animals suffering from trypanosomiasis had the incubation period delayed and their lives prolonged in the cold. (6) X-rays had no trypanocidal action, but the life of the animal may have been prolonged. (7) Leucocytic extract gave indefinite results.—A. **Campbell** and D. W. **Dye**: Sound vibrations of very high frequency produced by electric sparks.

Geological Society, December 7.—Prof. W. W. Watts, F.R.S., president, in the chair.—Dr. A. S. **Woodward**: Recent excavations in the cavern of La Cotte, St. Brelade's Bay (Jersey), made during the present year by the Jersey Society of Antiquaries. According to the report of Mr. E. T. Nicolle and Mr. J. Sinel, shortly to be published by the Jersey Society, the cave has yielded evidence of human habitation and traces of Pleistocene Mammalia. About a hundred flint implements of the Mousterian type have been obtained, besides part of a molar of *Rhinoceros antiquitatis*, and both teeth and antlers of *Rangifer tarandus*. Human remains and teeth of Bos have also been examined and determined by Dr. C. W. Andrews and Dr. A. S. Woodward, to whom the whole of the collection of mammalian remains was referred. This being the first discovery of typical Pleistocene Mammalia in the Channel Islands, the Jersey Society hopes to proceed with the excavations as soon as possible.—Dr. A. **Strahan**: The occurrence of recent shelly Boulder-clay and other glacial phenomena in Spitsbergen.

CAMBRIDGE.

Philosophical Society, November 28.—Sir George Darwin, president, in the chair.—Prof. **Pope**: Demonstration of natural colour photography of interference figures.—Dr. **Fenton** and W. A. R. **Wilks**: (1) Colloidal form of Nastvogel's osazone; (2) a method of characterising certain ureides.—H. O. **Jones** and D. I. **James**: The racemisation of malic and tartaric acids by heat.—Miss A. **Homer**: A note on the action of aluminium chloride on benzene.—Dr. **Forsyth**: Some theorems concerning uniform functions of two complex variables, together with some simple properties of such functions.—Dr. **Young**: Note on the fundamental theorem of integration.—H. C. **Pocklington**: (1) The determination of the exponent to which a number belongs, the practical solution of certain congruences, and the law of quadratic reciprocity; (2) the divisors of certain arithmetical forms, the primes of certain forms, and the arrangement of quadratic and some other residues.—L. **Doncaster**: Note on spermatogenesis of *Abraxas grossulariata*.—F. **Horton**: The discharge of positive electricity from sodium phosphate heated in different gases. A strip of platinum foil was covered with sodium phosphate and heated in a partial vacuum by means of an electric current. The positive leak from the heated strip to two parallel platinum plates, one on either side of it, was measured, when the following gases were, in turn, contained by the apparatus:—air, oxygen, carbon monoxide, hydrogen. It was found that the positive leak in oxygen was about the same magnitude as the leak in air. In carbon monoxide gas the leak was several times greater than the leak with the strip at the same temperature in oxygen or air at the same pressure. In hydrogen the leak was irregular, being when first tested about ten times as great as in carbon monoxide, but after heating for some hours it had diminished to less than the value in carbon monoxide under the same conditions. The fact that the positive leak is increased by admitting carbon monoxide into the apparatus is in accordance with the view that the positive ions from heated solids consist of molecules of this gas.—J. A. **Crowther**: The distribution of secondary Röntgen radiation round a radiator. The distribution of the secondary rays round a radiator under the action of a beam of primary Röntgen rays has been measured both for the "scattered" and for the "homogeneous" secondary rays. The scattered radiation rises to a maximum on both sides of the radiator in the line of the incident beam, and falls to a minimum at right angles to that direction. The maximum in the forward direction of the primary beam is considerably greater than that in the reverse direction. The homogeneous secondary rays are uniformly distributed round the radiator.—J. **Satterly**: The radium content of salts of potassium. Three years ago Campbell and Wood discovered that the salts of potassium were radio-active, giving off β rays. They tested the salts for radium and found none. In the opinion of the author their test was not as accurate as the occasion demanded, and he has performed some experiments in which the presence of radium in potassium salts is decisively proved. The amount, however, is extremely small (3×10^{-14} gm. radium per gm. of potassium salt), and does not interfere with Campbell and Wood's deductions.

EDINBURGH.

Royal Society, December 5.—Dr. Burgess, vice-president, in the chair.—E. M. **Wedderburn**: Temperature observations in the Madüsee (Pomerania), with mathematical discussion of temperature oscillations. A joint expedition with Prof. Halbfass, of Jena, was made in August to the Madüsee, a lake 17 km. long and 43 metres deep. About 3000 observations were made, and a temperature oscillation (or seiche) with a period of about twenty-five hours was observed, the oscillations at the two ends of the lake being in opposite phase. In the mathematical discussion of the oscillations of the bottom water in a lake of varying depth and breadth, the assumption was made that at a certain depth there was a sudden change of temperature, and therefore of density, and that the temperature was constant throughout each of the layers separated by this surface of temperature discontinuity. The period of the temperature oscillations depends on the differential equation

$$\frac{d^2P}{dv^2}+\frac{n^2}{g(\rho-\rho')\Sigma(v)}P=0,$$

where $v=\int b(x)dx$, $b(x)$ being the breadth of the surface of temperature discontinuity at a distance x from the origin taken in that surface; P is a function of v alone; ρ' and ρ are the densities of the upper and lower layers; and

$$\Sigma v = b(x)\Big/\left\{\frac{\rho}{A(x)}+\frac{\rho'}{A'(x)}\right\},$$

where $A'(x)$ and $A(x)$ are the areas of cross-section of the upper and lower layers. The equation is of exactly the same form as that used by Chrystal in his discussion of ordinary seiches. The period of temperature oscillation in the Madüsee, calculated according to this formula, is 24·9.—E. M. **Wedderburn** and A. M. **Williams**: Experimental verification of the hydrodynamical theory of temperature seiches. To verify the theory given in the last paper, laboratory experiments were made with a small trough of rectangular cross-section and parabolic longitudinal section. Paraffin oil represented the upper layer of warm water, and water the lower layer of cold water. The observed periods of oscillation in the lower liquid agreed well with calculation from theory. In some experiments the ends of the trough were truncated just above the surface of separation. As was anticipated by theory, this caused no appreciable alteration in the period of oscillation of the lower liquid.—Dr. Sutherland **Simpson**: Observations on the body temperature of the domestic fowl during incubation. The rectal temperature of the brooding hen was compared with the corresponding temperatures of a non-brooding or control hen. The modifications which were observed to occur during the brooding until a few days after the hatching were such as might be expected to occur because of the altered habits of the hen, apart altogether from the brooding condition.

PARIS.

Academy of Sciences, December 12.—M. Émile Picard in the chair.—W. **Kilian** and M. **Gignoux**: The fluvioglacial terraces of Bièvre and Basse-Isère. In a previous paper an account has been given of the pebble beds and terraces in the neighbourhood of La Valloire and Saint-Rambert-d'Albon. The present paper deals with the continuation of these beds towards the east, and leads to conclusions differing from the views now held as regards the relations of the external moraines with the terraces.—M. **Amann** and Cl. **Rozet**: The total eclipse of the moon of November 16, 1910, observed at Aosta, Italy. The contacts were observed under good conditions, the times of the two observers being concordant.—M. **Borrelly**: Observation of the Faye-Cerulli comet made at the Observatory of Marseilles with the comet finder. Positions of the comet and comparison stars are given for November 22, 23, and 26, and December 1 and 2. The comet appeared to be between the eleventh and twelfth

magnitude.—M. **Esmiol**: Observations of the comet 1910*e* (Faye-Cerulli) made at the Observatory of Marseilles with the Eichens equatorial of 26-cm. aperture. Positions given for December 1 and 2.—Maurice **Servant**: Transformations of surfaces applicable to surfaces of the second degree.—E. **Blutel**: The application of Newton's method of approximation to the approximate resolution of equations with several unknowns.—Léon **Autonne**: Commutative groups of hypercomplex quantities.—M. **Galbrun**: The asymptotic representation of the solutions of an equation of finite differences for large values of the variable.—W. **Stekloff**: The conditions of closing of systems of orthogonal functions.—H. **Violette**, E. **Lacour**, and Ch. **Florian**: Telescopic sights for marine guns of small calibre.—Georges **Claude**: Luminescent tubes containing neon. Photometric measurements have been made with a tube containing neon, 6 metres in length and 45 mm. diameter. Traces of impurities in the neon were found to be very prejudicial, and details of the method of purification found to be necessary are given. The efficiency was found to be 0·8 watt per candle, but this efficiency can be raised by increasing the length of the tubes, and reasons are given for hoping that about 0·5 watt per candle can be ultimately obtained.—G. **Massol**: The chemical composition of the gases spontaneously given off by the thermo-mineral spring of Uriage, Isère. The gas contains 1·87 per cent. by volume of rare gases, about one half of which is helium. From an estimate of the total gas evolved from the spring, it is concluded that not less than 20 litres of helium per day could be obtained from this spring.—Léon **Guillet**: The softening of metals after wire-drawing. Specimens of nickel and steel drawn into wires have been studied from the point of view of the annealing temperature.—E. **Léger**: The action of nitric acid upon the aloins: the production of tetranitroaloemodine and trinitro-2 : 4 : 6-meta-oxybenzoic acid.—Marcel **Godchot**: Hexahydro-acetophenone and hexahydrobenzoylacetone. Hexahydro-acetophenone on oxidation with alkaline permanganate gives adipic acid; the preparation of the oxime of this ketone and of hexahydroacetanilide are also described.—Paul **Gaubert**: The influence of foreign substances dissolved in the mother liquor on the facies of crystals of meconic acid and on their pseudopolychroism.—Louis **Duparc** and Georges **Pamphil**: Issite, a new rock in dunite. Issites are holocrystalline amphibole rocks of variable grain. Five complete analyses are given.—J. **Couyat**: Sodium rocks of the Arabian desert.—Ch. **Mauguin**: Doubly refracting liquids of helicoidal structure.—V. **Vermorel** and E. **Dantony**: General principles which ought to be followed in establishing formulæ for insecticides. It is shown that the quantities of soap used in insecticidal preparations can be reduced from 5 per cent. to 1 in 1000 without the moistening powers of the solution being adversely affected. Methods have been worked out for the employment of sulphur in such solutions.—L. **Moreau** and E. **Vinet**: Lead arsenate in viticulture and its distribution on the fresh and dried grapes. If the treatment is applied before flowering there is no danger of contamination by arsenic; if the application is delayed until after flowering, traces of lead arsenate are present on the grape.—MM. **Griffon** and **Maublanc**: A parasitic disease of the chestnut.—A. **Brissemoret** and A. **Joanin**: Contribution to the study of the physiological action of the organic bases. The sleep which is produced in the dog by the administration of conicine is due to the hydrocarbon residue in the base. Phenomena of narcosis analogous to those produced in the rabbit by morphine can be obtained by the action of hexahydrophenanthrene.—J. Künckel **d'Herculais**: The relation between the insects (Lepidoptera) and the flowers of the Zingiberaceæ, and in particular with those of Hedychium. Their capture, its mechanism, and its consequences.—M. **Roubaud**: Details concerning the morphological phenomena of the development of trypanosomes in Glossina.—E. **Sollaud**: The affinities of the genera Urocaris and Palæmonella.—Gabriel **Bertrand**: Observations on a note relating to the action of the Bulgarian ferment on proteid materials. Criticisms of a recent note by M. Effront.—Jean **Boussac**: The phenomena of folding in the Italian maritime Alps and at Castelvecchio.

VICTORIA.

Royal Society, November 10.—Prof. E. W. Skeats in the chair.—H. R. **Hamley** and A. L. **Rossiter**: The magnetic properties of "Stalloy." As the result of a research by (*a*) direct current, (*b*) alternating currents of different frequency, the authors conclude that, previous to annealing, "Stalloy" is of very little use, but that when annealed it furnishes an almost ideal material for the construction of electric machinery.—W. **Stapley**: The morphology of the vermiform appendix. The formation of a true appendix is shown to be due, not to the presence of lymphoid tissue, but to an atrophy of a larger cæcum, the peculiar shape and position being due to the disposition of the longitudinal bands.—William **MacKenzie**: Some observations on the comparative anatomy of the fibula. The fibula is held to be undergoing recession among the higher mammals, its future complete loss being indicated by the occurrence of congenital cases of absence of fibula in man. This loss is considered to be due to the assumption of the erect position.—Hilda **Kincaid**: The bio-chemical significance of phosphorus. Imported grasses and cereals have a lower phosphorus content than the same species grown in Europe, but a higher phosphorus content than native Australian plants. Victorian soils are poor in phosphorus. Animal tissues, eggs, and milk in Australia have a phosphorus percentage equal to the European. The export of phosphorus in the form of animal carcases is considerable.

CONTENTS.

THURSDAY, DECEMBER 29, 1910.

MALARIA PREVENTION.

The Prevention of Malaria. By Major Ronald Ross, C.B., F.R.S. With contributions by Prof. L. O. Howard and others. Pp. xx+669. (London: John Murray, 1910.) Price 21*s.* net.

FEW if any subjects bearing on the prosperity of tropical lands can be of greater importance than the effective control of those tropical diseases which have often proved barriers, sometimes insuperable, to their development. This will readily be admitted with reference to the colonisation of such lands by white men, but it is of at least equal importance for the welfare of the indigenous races the progress of which towards a higher civilisation is most intimately bound up with an increased immunity from disease and a higher standard of hygienic environment.

Of all the diseases prevalent in tropical and subtropical countries there is none to compare with malaria, either in point of view of frequency or of disastrous results in respect of the general health of a population. This has been acknowledged to a certain extent from the earliest times, but it has been left for modern science to demonstrate the true magnitude of the problem and to point out scientific and practical measures by which the damage caused by malaria may be controlled.

In this volume, by Major Ronald Ross, we have an admirable account of the whole of the many-sided problem of malaria prevention, stated in clear and eloquent fashion, and developing the subject in so logical a sequence that the reader is carried in complete sympathy with the author towards an acceptance of the preventive measures which he advocates as being the best at present available.

No one has better right to speak with authority on every branch of the subject than the author, whose discovery of the mosquito transmission of the disease laid the foundation for the majority of the preventive measures which have already been of inestimable service to humanity. The discovery of the malarial parasite by Laveran, epoch-making as it was, in itself did little to help in the prevention of the disease, and only a knowledge of the complete life-history of the parasite could teach us where and how to apply measures directed towards the prevention of this scourge of humanity.

Since this knowledge became available, numerous books have appeared, in many tongues, dealing with prevention, but the immense majority of these are either purely technical or purely popular, and there was a distinct place for a volume such as this, which, while avoiding unnecessary technical and medical detail, deals with each branch of the subject in comprehensive fashion and affords such a complete guide as is imperatively needed by all who have to deal with the subject practically, whether from the point of view of the health officer or from that of the civil administrator of a country or district. To obtain success in a malaria campaign it is not enough to be told what to do, one ought to know in addition the "why" of each step.

Throughout the whole of the work the author speaks, as he obviously feels, strongly on the half-hearted manner in which preventive measures have been applied by many bodies in administrative control of various malarious countries. He acknowledges that in many instances the cause of this official indifference is apprehension of excessive expenditure, but he shows clearly that, even from this low point of view, a grudging expenditure is bad finance. Granted that the measures he so ably advocates are carried out with intelligence, and under continuous and proper supervision, few who follow his arguments and examples will differ from him that few items in a colonial budget would have been better expended.

After an interesting historical account of malaria, from the earliest classical allusions to the discovery of the parasites and of the mode of transmission by anopheline mosquitoes, a clear account is given of the fundamental observations and experiments which have led up to our present-day knowledge. Next follows a most interesting chapter on the parasitic invasion of man. This will be read with perhaps the greatest interest by those who have practical knowledge of the disease, since it is replete with information of the most valuable character on such points as the number of parasites which may be introduced by the mosquito, the number which must develop from those introduced before illness is produced in man, the period of incubation, the limitation of the invasion, &c. Even those who are familiar with most of the subject-matter here dealt with will find much to interest them, since there is scarcely a point discussed which has not a direct bearing upon the question of prevention.

Major Ross lays great stress upon the necessity for a more accurate study of the disease by exact quantitative methods, and his arguments and illustrations in connection with this point will find general acceptance. For instance, he advocates a more accurate study of the numbers and local distribution of the particular anopheline mosquitoes which are found to transmit malaria in a given locality, since, without such a foundation, it is not possible to judge with any degree of accuracy as to the effects of the measures which may have been adopted with a view to their destruction. Again, in assessing the value of different preventive measures, such as mosquito destruction, the systematic use of quinine or the protection of individuals by mosquito netting, an accurate measure of the amount of malaria present in a particular population is an essential preliminary. He devotes considerable space to the best means by which such estimations may be carried out, and discusses the relative value of estimates of the actual number of individuals who have parasites in their blood at a given time, the estimation of the number who show signs of present or recent infection by enlargement of the spleen, the constantly-sick-rate, the death-rate, &c. He concludes that the most generally useful of these is the spleen-rate, since an actual microscopical examination of the blood demands too great labour. In this connection a good example of his mathematical reasoning shows that in a quarter of an hour a careful microscopical examination of a sample of blood for

parasites will only have searched one-fiftieth of a cubic millimetre. Now, since this volume is only about 1/150,000,000 of the blood in a man's body, it follows that there is a considerable chance that not a single parasite might be detected, although the individual might have 150 million of them in his circulation at the time!

Major Ross's preference for the determination of the "spleen-rate" appears justifiable on grounds of expediency, but, although he points out most of the more obvious fallacies to be guarded against in making such estimations, he scarcely appears to attach sufficient importance to these. For instance, there is very little experience accumulated as to the length of time which some degree of splenic enlargement may persist after recovery, while the splenic enlargement caused by ankylostomiasis, as has recently been pointed out by Darling, would invalidate the tests in certain localities.

The section dealing with the laws which regulate the number of anophelines in a locality will be fascinating reading to all who have some practical knowledge of these pests, and is full of most suggestive matter, much of which will doubtless be put to the test by those who have opportunity. The problem of attempting the destruction or limitation of mosquito life, under conditions where extensive breeding places abound, and where the usual measures appear at first sight impracticable, are boldly faced, and those who are satisfied with Major Ross's mathematical demonstrations on such points as the variations of mosquito density due to various causes, the random scatter of mosquitoes from a given point, &c., will find it necessary to revise some views which have been and are extensively held on the impossibility of limiting the mosquito population in certain conditions.

The thoroughness with which the earlier portions of the book have dealt with all branches of the subject greatly adds to the value of the chapter dealing with the selection of the preventive measures to be made in a given instance, since one is able to follow the author in his clear exposition of the manner in which one must study the local conditions in every instance before deciding on the plan of campaign. As he is careful to point out, without such close study of these conditions a scheme might be drawn up which was foredoomed to failure, and large sums of money might uselessly be thrown away. The chapter abounds in valuable practical hints for the guidance of those responsible for the organisation of such campaigns, and it may also be studied with the greatest profit by laymen whose only desire is to know how best they, individually, may avoid infection on proceeding to a malarious country.

The second half of the book consists of a series of articles by well-known authorities dealing with experiences of individual malarial campaigns in many countries, and these afford a number of object-lessons in the application of the principles enunciated in the first half. There are altogether twenty-one contributors to this portion, and the majority are recognised authorities on the subject of malaria in the particular country dealt with. For instance, the campaign against malaria in Italy is from the pen of Prof. Celli, while that dealing with the most successful of all malarial campaigns, that in the Isthmus of Panama, has been written by Colonel Gorgas. Dr. Schilling deals with malaria in German possessions; and the measures employed in French territory are described by Dr. Edmond Sergent. The completeness of this portion of the book is indicated by the fact that it concludes with two most interesting articles on the prevention of malaria in troops in war and in peace, the former by Lieut.-Colonel C. H. Melville, and the latter by Major C. E. P. Fowler, who was associated with Major Ross in his campaign in Mauritius, to which so many allusions are made in the systematic portion.

Major Ross and his collaborators may be congratulated on having produced a work which will be of the highest value to all who are concerned with the future progress and welfare of our tropical possessions.

W. B. L.

THE BRITISH MUSEUM COLLECTION OF FOSSIL REPTILES.

(1) *A Descriptive Catalogue of the Marine Reptiles of the Oxford Clay, based on the Leeds Collection in the British Museum (Natural History), London.* Part i. By Dr. C. W. Andrews, F.R.S. Pp. xxiii+205+x plates. (London: Printed by order of the Trustees of the British Museum, 1910. Sold by Longmans and Co., B. Quaritch, and Dulau and Co., Ltd.) Price 25*s*.

(2) *A Guide to the Fossil Reptiles, Amphibians, and Fishes in the Department of Geology and Palaeontology in the British Museum (Natural History).* Ninth edition. Pp. xviii+110. (London: Printed by order of the Trustees of the British Museum, 1910.) Price 9*d*.

(1) THE museum having acquired the unrivalled collection of reptilian remains obtained with much labour and unceasing care by the Messrs. Leeds—more especially Mr. A. N. Leeds—from the brick-pits in the Oxford Clay near Peterborough, it was only fitting that they should be described in a manner worthy of their importance and value. So far as the marine forms are concerned, that is to say, the ichthyosaurs, plesiosaurs and pliosaurs, and crocodiles, the task has been entrusted to Dr. C. W. Andrews, who for several years past has devoted a large portion of his time to the study of these groups. How thoroughly well he has accomplished the work will be apparent to all specialists who study the present volume, which deals with the ichthyosaurs and plesiosaurs.

The work appeals, however, to other than specialists, for it not only serves to make known the remarkably fine state of preservation in which many of the skeletons of these strange reptiles are found, but it also contains a number of interesting observations with regard to their probable mode of life and the conditions in which they existed. So nearly complete, indeed, are many of the skeletons, that not only has it been found possible to mount several for public exhibi-

tion, but, owing to the separation of their constituent elements, the details of the osteology can be studied, except in the case of the skull, which is often badly crushed, as if they belonged to modern reptiles. It should be added that this full acquaintance with the osteology of these saurians is largely due to the extreme care exercised by Mr. Leeds in extracting them from the matrix.

The remains are generally supposed to have been laid down in rather deep water, but the association of the marine forms with terrestrial dinosaurs, and perhaps also the occurrence of masses of lignite, suggests that the deposit was formed near a coast, and not improbably represents the mud-banks in the delta of a mighty river. Here Ophthalmosaurus, the single and most highly specialised representative of the ichthyosaurs, with its powerful caudal fin, pointed head, enormous eye, and porpoise-like body, probably lived in the open sea, where it played the part now assumed by whales and grampuses. Why this particular type should have become practically edentulous, whereas its upper Cretaceous successors were remarkable for their powerful dentition, is somewhat difficult to understand, although, as Dr. Andrews suggests, this feature was probably connected with the nature of its food. Certain features in its organisation suggest that it was capable of "sounding" to considerable depths.

In marked contrast to the movements of this ichthyosaur were those of the contemporary plesiosaurs, which were far more specialised types than their forerunners of the Lias. Instead of being driven through the water by the screw-like action of a powerful tail-fin, these appear to have rowed themselves on or near the surface by means of their strong paddles, of which the hind pair was nearly equal in capacity to those in front, whereas the tail was short, and provided, at most, with a rudimentary fin. Their whole organisation indicates that they haunted the neighbourhood of the coasts, whereas their short-necked and more strongly built relatives the pliosaurs may be assumed to have ventured further out to sea, although they did not possess the truly pelagic habits of the whale-like ophthalmosaur. The littoral habits of the plesiosaurs exposed them to much more varied conditions of life than was the case with the last-named reptile; and it was these diverse conditions which probably led to the differentiation of the group into the numerous types so well described in the volume before us.

To follow the author through his survey of the osteology of the groups forming the subject of this volume would demand much greater space than the editor is disposed to grant. Attention may, however, be directed to the figure on p. 12 illustrating the form and arrangement of the constituent bones of the occipital region of the ophthalmosaurian skull, and more especially to the remarkable position and relations of the opisthotic and stapes. The great length of the parasphenoid element (p. 15) is also noteworthy, while of even greater interest is the author's reference of the ichthyosaurian humerus to its proper side of the body (p. 52). Among the plesiosaurs it must suffice to refer to the determination of the relations and form of the clavicles and interclavicles, and especially the gradual waning of the latter (compare Figs. 61, 62, 70, 88).

Dr. Andrews has a good deal to say as to the phylogeny of the ichthyosaurs, for which readers must refer to the work itself; that of the plesiosaurs and pliosaurs is reserved for the second volume, which we hope to welcome before many months are past.

(2) Passing on to the guide-book to the fossil reptile and fish galleries, the mere fact that a new edition has become necessary after the lapse of only five years from the issue of its predecessor (which was entirely re-written), affords sufficient evidence that the work meets the requirements of the class of visitors for whom it is intended. As we are told in the preface, the new edition is practically a replica of the eighth issue, and therefore demands no special notice in this place. It may be noticed, however, that the price has been raised from sixpence to ninepence, at which figure the work is still a marvel of cheapness. In the next edition it might be well to explain the meaning of "type" specimens (*vide* preface), of which the general public has no conception, and likewise to amend the legend to Fig. 39, which states that the specimen belongs to a small tortoise, whereas it is really something like twenty inches in length.

R. L.

ELECTRO-CARDIOGRAMS.

Das Elektrokardiogramm des gesunden and kranken Menschen. By Prof. Friedrich Kraus and Prof. Georg Nicolai. Pp. xxii+322. (Leipzig: Veit and Co., 1910.) Price 12 marks.

THE electrical phenomena of the living heart has been a fascinating study among physiologists since the early days of electro-physiology; information has been gathered with greater and greater accuracy as apparatus and methods of investigation became more and more refined, and now the registration of the electrical changes in the heart may be, and is, practically employed in the diagnosis of heart affections in the wards of the hospital. A full discussion of the origin and progress of method in this direction is given in this book, which has been produced by authors well acquainted practically with all the details of this branch of physiological and clinical inquiry. The progress of research is strikingly shown in a bibliography at the beginning of the work containing a list of 243 papers on the subject, of which no fewer than 131 have appeared since the beginning of 1900.

It is interesting to notice that investigations into the electrical phenomena of the heart are associated at different periods with the invention of special instruments and methods, such as the galvanometers of Matteucci and du Bois Reymond, the differential rheotome of Bernstein, the capillary electrometer of Lippmann, and, still more recently, the string galvanometer of Einthoven. Matteucci, in 1843, was the earliest observer with the galvanometer; then, in 1849, followed du Bois Reymond with his bussole; Köllker

and Müller worked about 1856, Donders about 1872; and at last there were the elaborate researches of Engelmann from 1873 to 1877. Gotch and Burdon Sanderson studied the phenomena of inhibition in the heart of the tortoise in 1877; Bernstein, du Bois Reymond, Engelmann, Hermann, and Burdon Sanderson used the rheotome between 1868 and 1887. Then followed the invention of the capillary electrometer by Lippmann in 1873; it was soon used by Engelmann and Marey, and in 1883 it was employed in research by Burdon Sanderson and Page. Waller, in 1889, was the first to employ the instrument in the investigation of the human heart. The actual oscillations in the tube of the capillary electrometer were photographed on a rapidly moving plate, so as to produce a cardiogram, and with this invention the names of Burch and Burdon Sanderson will be always associated (1890). In more recent times we have the invention of the string galvanometer by Ader in 1897, and perfected by Einthoven, until it must be regarded as by far the most sensitive instrument for the purpose. The instrument, as now constructed, is much more delicate than the original instrument of Ader, while the apparatus had been made complete by the photographic registering apparatus made by various ingenious workers in optics and mechanics.

The accurate interpretation of the electro-cardiogram owes much to Waller, who established important leading principles on which monophasic and diphasic currents can be explained. He also gave a schematic representation of the action currents that can be led off from the living human heart (Fig. 16, p. 45). In the work under notice, there is a full description of the principle and mechanism of the string galvanometer, and an analysis of the curves produced from it (p. 64). The introduction of the quartz fibre has most materially increased the delicacy of the instrument. There can be no doubt that only an expert can use the instrument in a satisfactory manner, as is well illustrated by a study of the diagram of the apparatus in an actual experiment in Fig. 28, p. 89. This method is much more complicated than the simple galvanometer experiments once in vogue in every physiological class-room or laboratory.

Kraus and Nicolai then give a thorough analysis of the electrocardiogram, showing in the diphasic effects groups of electrical oscillations in the curve which are associated with the contractions of the auricle, with those of the ventricle, and with changes occurring also during the diastole of the ventricles and the filling of the auricles. The time relations of all those phenomena can also be accurately determined; indeed, an insight is obtained into the phenomena of the living beating human heart not otherwise possible. They also endeavour to show that those phenomena may be explained or accounted for by our knowledge of the muscular arrangements of the walls of the heart. Without mentioning the old researches of Borelli or the more recent dissections of Pettigrew (to be seen in the museum of the Royal College of Surgeons, Lincoln's Inn Fields), they describe the spiral arrangement of the fibres, the relation of many of the fibres to the papillary muscles, the fibres of Wenckebach (1901) between vena cava and the auricle, and the bundle of His (1893) between auricle and ventricle. Nearly thirty years ago there appeared the classical research of Gaskell (1883) on the heart of the tortoise, which showed the passage of impulses from auricle to ventricle, and was the beginning of much work of great clinical as well as physiological importance. The analysis of many electrocardiograms is given with great care and thoroughness by the authors in chapters vi. to x., and to those the reader must be referred.

The second portion of the work relates to the clinical use of the string galvanometer in the investigation of diseases of the heart and of the circulation. When one considers that the complete apparatus costs from 200*l.* to 250*l.*, and that a special knowledge of electrical appliances is required, it will be evident that the method cannot be expected to come into general use, even in the wards of a well-appointed hospital. Physicians will depend more on mechanical appliances for registering the movements of the various pulses (both venous and arterial) and of the heart itself, a method of sphygmographic investigation that has received a new lease of life by the labours of Mackenzie and others. At the same time it must be admitted that the electrical phenomena give a glimpse of phenomena actually happening in the heart which would escape detection by the mechanical method, as, for example, slight changes in the beat of the auricles, and some phenomena which may account for want of rhthym, as when the auricles and ventricles do not beat in the normal consecutive order. The time relations can also be accurately noted. The authors give many cardiograms well worthy of the study of physicians. These must not be confounded with the tracings that, by other methods, may be obtained of the vibrations of the sounds of the heart. Science must advance, but it is rather disheartening to be obliged to take the view that these elaborate researches have very little to do with the actual treatment of diseases of the heart, and the sufferer whose heart is beating arhthymically will find cold comfort in the certain knowledge that there is some kind of fatty or other degeneration in the fibres of the bundle of His in his cardiac organ.

Since the above was written a valuable paper has appeared in *Heart* by Dr. Thomas Lewis and B. S. and Adele Oppenheimer on "The Site of Origin of the Mammalian Heart Beat; the Pace-maker in the Dog." The researches have been carried out with the string galvanometer, with special reference to the electrical relations of the collection of specialised tissue at the upper caval end of the sulcus terminalis of His. The tissue, or node, as it may be termed, was discovered by Keith and Flack. Dr. Lewis and his co-workers find electrical evidence to show that it is the site of primary activity, that is to say, from it impulses radiate that are the cause of the co-ordinated heart beat. This result, long sought for by other observers, is an important addition to cardiac physiology, while it illustrates the value of the use of the string galvanometer.

JOHN G. MCKENDRICK.

AUSTRALIAN TRIBES.

(1) *The Tribe, and Intertribal Relations in Australia.* By G. C. Wheeler. With a prefatory note by Prof. Edward A. Westermarck. Pp. xii+168. (London: J. Murray, 1910.) Price 3*s.* 6*d.* net.

(2) *Two Representative Tribes of Queensland, with an Inquiry concerning the Origin of the Australian Race.* By J. Mathew. With an introduction by Prof. A. H. Keane. Pp. xxiii+256. (London: T. Fisher Unwin, 1910.) Price 5*s.* net.

ACQUAINTANCE with the interesting political and social organisation of the Australian aborigines has gradually destroyed the tradition of their primæval simplicity, and the information collected and classified by Mr. Wheeler (1), during his work as Martin-White student of sociology in London University, shows that intertribal relationships in Australia are unusually well regulated. Mr. Wheeler declares that "in contrast with the loose ideas generally held war in these tribes cannot be deemed a normal condition," and Prof. Westermarck, in a prefatory note, remarks "among the Australian aborigines the germs of international law" and "something like an anticipation of the Geneva Convention." Instead of the Australian aborigines retaining a primitive communism, territorial ownership is so fully recognised that, according to Mr. Wheeler (p. 161), "War has no other purpose than the seeking of justice or revenge for injuries done." War there, he says, is never for the sake of territorial conquest, as the right of the lawful owners of land is regarded as absolute.

The main purpose of Mr. Wheeler's study is to collect the available information as to the relationships of the Australian tribes. He summarises the evidence as to their confederations, the rights of territorial sovereignty, the regulations which govern tribal intercourse—including barter, asylum, and the safety of envoys, the punishment of offenders belonging to different tribes, and war. The essay is a discussion of second-hand evidence, in the valuation of which the author is perhaps not always successful. Thus, he disparages Howitt's work, since, as that author carefully explained the source of his information, it is obvious how much of it came from others; but Mr. Wheeler is less cautious in regard to some authorities, in whose writings observation and inference are less easily distinguished.

The essential difficulty in the study of intertribal relationships among the Australians is the absence of any trustworthy distinction between tribes and intertribal local groups, and between tribes and "nations." Mr. Wheeler uses the term nation occasionally, but regards it as inappropriate in Australia, as the groups are so indefinite. He admits that there is no firm line to be drawn between nations made up of tribes, and tribes made up of local groups; and he recognises that the relations between local groups of the same tribe do not differ from those of local groups belonging to different tribes. The intertribal regulations, which Mr. Wheeler's study shows are so widely recognised in Australia, therefore deal with the relations of local groups, which have been perhaps only recently and temporarily isolated or combined, and not of tribes separated by racial differences, as in India or Africa, or by traditional feuds, as in North America.

According to Mr. Wheeler, the best test of a tribe (p. 55) is that the intertribal groups do not carry on unregulated warfare, and during warfare do not eat the dead. According to Mr. Mathew, on the other hand, tribal distinctions are based on language.

(2) Mr. Mathew's book may be divided into two distinct sections. Its main value is an account of the Kabi and Wakka tribes, who inhabited the basins of the Mary River and upper Burnett River in southern Queensland. The author had excellent opportunities for the study of the Kabi, as he lived among them from 1866 to 1872, and has re-visited them in 1884 and 1906. He knows their language and appears carefully to have observed their habits and collected their beliefs and folklore. Mr. Mathew's most interesting chapter is upon religion and magic. He concludes that "these tribes possessed the elementary contents of religion" (p. 168), and had some belief in supernatural beings, of whom they spoke with reverence and of whom the "great supernatural" was nameless and was referred to only with bated breath.

The value of Mr. Mathew's book is reduced by his constant re-statement of the theory which he advanced in 1899, in his "Eaglehawk and Crow," and in an earlier paper. He there claimed that the two totemic divisions named after the Eaglehawk and Crow were due to racial differences; he believed that the Australian aborigines have originated from the fusion of a dark "Papuasian" people, who were of the same race as the Tasmanians, with a fairer people who were possibly connected with the Dravidians of India, the Veddas of Ceylon, and the Toalas of Celebes. He re-states this view in an introductory memoir, and repeats it, but without mentioning the strongest objections to it, and still claiming in its support authors, such as Lydekker—who has long since abandoned it. Mr. Mathew admits that some tribes outside Australia are also divided into two exogamous classes, and he appears disposed (p. 140) to extend his racial theory to those cases. Moreover, many Australian tribes are divided into four classes instead of into two, and as Mr. Mathew admits that the fourfold division is not racial, it seems unnecessary to adopt his explanation for the division of the tribes into two classes. Mr. Mathew states that the light-blooded and dark-blooded sections may still be recognised among the Australians; but, in quoting one of these cases he admits (p. 142) that his informants differed as to which section was the light and which the dark. The difference in colour appears to be as slight as the rest of the evidence in favour of Mr. Mathew's theory. The account of the Kabi is, however, a useful contribution to Australian anthropology.

SOME CRITICAL SPECIES OF VERONICA.

Veronica prostrata L., Teucrium L., und austriaca L. nebst einem anhang über deren nächste verwandte. By Dr. Bruno Watzl. (Abh. der K.K. Zool-Botan. Gesellschaft in Wien. Bd. v., Heft 5.) Pp. 94+Tafel xiv. (Jena: Gustav Fischer, 1910.) Price 7 marks.

DR. WATZL has made a detailed study of three closely-allied species in what is generally recognised as a very critical genus. Bentham, when mono-

graphing the family Scrophulariaceæ in De Candolle's Prodromus (1846), grouped these species with a few others as a subdivision Pentasepalæ of the section Chamædrys, characterised and distinguished from other subdivisions, and the majority of the species of the genus, by the five-toothed calyx as contrasted with the usual four-toothed organ. The disappearance, by gradual reduction, of the median sepal is one of the factors in the diminution of the zygomorphy, which is a feature of the Veronica flower when compared with the more strikingly zygomorphic forms typical of the family. These pentasepalous forms are to be regarded as an older type from which the more numerous tetrasepalous have been derived, and Dr. Watzl again directs attention to the fact that the character is a variable one, four-sepalled flowers being of frequent occurrence.

None of the three species which are the subject of the memoir occurs in the British Isles, but they are widely distributed in central and southern Europe. *Veronica prostrata* is the most constant of the three; besides the type only one form and one variety (from Siberia) are recognised. There is, however, a considerable amount of variation in habit, degree of hairiness, and size of parts; and, as shown by plate v., the leaf displays great variety in size and form in specimens from different localities. The other two species are remarkably polymorphic, and are subdivided by the writer into a series of subspecies, varieties, and forms, with, in several cases, a number of transitional forms between the different subspecies. Dr. Watzl has made a careful and exhaustive study of a large series of specimens from central and southern Europe, as well as of the citations in the numerous European floras, and the results of his work will have a special interest for the critical student of the European flora. It is inevitable, however, that the personal element should enter into such a detailed study of a highly variable species occurring over a somewhat extended area, and it is probable that other critical students of the same group would not entirely concur with the limitations of forms and varieties which are adopted by Dr. Watzl.

A. B. R.

SCHOOL DRAWING.

(1) *A Course of Drawing for the Standards. Being a Selection of Sheets from "A Complete Course of Free-Arm and Industrial Drawing."* By J. W. T. Vinall. Pp. 24+xxiv charts. (London: Blackie and Son, Ltd., 1910.) Price 6*s*. net.

(2) *Natural and Common Objects in Primary Drawing, with Full Directions as to Their Use. A Handbook for Teachers.* By J. W. T. Vinall. Pp. v+68. (London: Blackie and Son, Ltd., 1910.) Price 3*s*. 6*d*. net.

(1) THE issue of the author's "Complete Course of Free-Arm and Industrial Drawing," in sections is a wise step that will be much appreciated by teachers. The first portion, published as "A Course of Kindergarten Drawing, for Infants and Small Children," has now been followed by a second and more advanced selection under the title given above. It outlines a progressive school course for youths from six years upwards, corresponding to standards I. to VII. and beyond. The first six plates deal with brush work and the principles of colour harmony, with applications to natural objects and ornamental designs. The next six illustrate a well-graded course of free-arm drawing in coloured chalks, based on circular, elliptic, and compound curves. The applications to natural and familiar objects, to ornamental patterns and designs, with reference to the laws of growth, repetition, and radiation, are very numerous and intensely interesting. The remaining charts comprise free-hand drawing in pencil, crayon, and with the pen; further brush work and shading; and model and perspective drawing, with technical and other applications. The plates are accompanied by a very lucid and suggestive description that will prove most valuable to teachers. They are beautifully executed, generally in colours. As a whole, the work forms as admirable a course of school drawing as could be desired, and impresses the reader with the great educational value of training conducted on lines indicated by the author.

(2) This is a new work, intended to be supplementary to the one noticed above, its main object being to assist the teacher in the selection of objects, properly graded and suitable for class instruction in drawing in elementary schools. It is based on the syllabuses of the English and Scottish Boards of Education. The objects are displayed in a number of plates, to which teachers will often be glad to refer. The illustrations include familiar objects in common use, nature forms and specimens, subjects for measured drawings, and specimens of alphabets and printing. The plates are described in the text, and are preceded by a general discussion of the aims and qualifications of the teacher, of the apparatus used, and of the methods of work. The book can be recommended to teachers as affording valuable guidance in their work.

OUR BOOK SHELF.

Iron and Steel Analysis. Vol. i., Ordinary Constituents. By A. Campion. Pp. 80. (Glasgow: Fraser, Asher and Co., Ltd. 1910.)

THIS small handbook gives a detailed account of the methods used in determining the six or seven elements invariably occurring in pig-irons and ordinary steels, and also those employed in the proximate analysis of coal.

With few exceptions, one method only is described for each element, and in every case one which has been in use (with modifications) in steel-works' laboratories for many years. Although, therefore, there is nothing new by way of contribution to the existing literature on the subject, the book is eminently suited to beginners. It is doubtful, however, whether the author's hope that works chemists will find the book useful will be realised, as some of the methods described are by no means quick enough. Rapidity, consistent with accuracy, is a very important consideration in steel-works laboratories, a fact which the author obviously recognises in the preface.

The opening out of grey irons with hydrochloric acid in silicon determinations, as described in this

book, has been largely superseded by the more rapid and trustworthy process of Drown. The gravimetric methods described for manganese and phosphorus are cumbersome. In the case of the former, the importance of neutralising the acid solution of ferric and manganese chlorides at a boiling temperature is wrongly insisted upon, and the washing of the voluminous basic ferric acetate precipitate should have been avoided.

Manganese furnishes one of the cases in which alternative volumetric methods are described, the first of which is undoubtedly more accurate than the gravimetric method as carried out by the author. An alternative process, preferably volumetric, for the determination of phosphorus, would have materially increased the value of the book. The other elements, and particularly the most important one (carbon), are dealt with in a very satisfactory manner. F. I.

The Potter's Craft. A Practical Guide for the Studio and Workshop. By F. Binns. Pp. 171. (London: Constable and Co., Ltd., 1910.) Price 6s. net.

THE preface leads to great expectations, for the author says:—"This book is the outcome of an experience extending over a period of thirty-six years. Twenty years ago it would have been impossible for the science of ceramics was not then born." The book itself is, however, very disappointing, and cannot be considered as a serious contribution to ceramic science. It is written apparently for the amateur potter; it certainly would not be of use to anyone else, and there is nothing in it that was not known twenty years and more ago.

Much of the book is taken up with photographs and descriptions of two well-known processes, viz., "mould-making" and "throwing." These could be much better learnt and understood by a visit to a pottery; certainly no one will ever learn to be a craftsman by studying the book. When one knows the time it takes for a professional potter to learn to throw even simple small pieces to a given size, it seems almost ludicrous to write as the author does of an amateur making vases two or three feet high by doing the work in sections. The chapter on glazes and glazing can lead to nothing but disappointment.

It is hard to believe that the author has had great practical experience when we see him trying to deal with "the defects of glazes" in about two pages. For example, practical men know what a difficult problem "the pinholing of glazes" is, and how many and varied are the causes which produce it. Mr. Binns devotes two lines to it!—"Pinholes appear in the glaze when cool. Too rapid cooling is the cause." It is difficult to write with patience of this kind of treatment, particularly when we remember the preface.

Heroes of the Elizabethan Age. Stirring Records of the Intrepid Bravery and Boundless Resource of the Men of Queen Elizabeth's Reign. By E. Gilliat. (London: Seeley and Co., Ltd., 1911.) Price 5s.

THE stout-hearted men who sailed the seas in the days of England's awakening were indeed heroes. Their charts were made with the degrees of longitude at different latitudes of equal length; they were inaccurate even as regards the shores of the English Channel, for it is one of the claims to renown of John Davis that he surveyed the Channel coasts in addition to those of the Arctic, of Magellan Straits, and of the Scilly Isles. They dared to cross the Atlantic in ten-ton vessels, for the *Squirrel*, in which Sir Humphrey Gilbert was lost, was of this size; they took five months on the voyage to the Cape of Good Hope, and the chances were that disease alone would kill off a large proportion of the crew of every vessel which went on a protracted voyage.

Englishmen fitted out expedition after expedition; many times for no return, sometimes for a return of hundreds per cent. on their outlay, for the capture of one rich carrack might suffice to pay the cost of a large expedition. In this atmosphere Hawkins began the slave trade, Sir Richard Grenville fought his good fight off the Azores, and Howard and his captains harassed the Armada and made its efforts fruitless. In this spirit Sidney died at Zutphen. These heroic efforts form part of the great struggle for Protestantism which lies at the background of the life-story of the thirteen heroes as depicted in this splendid gift-book by a sometime master at Harrow School. Well illustrated and produced, this book will delight the heart of most boys and many girls, even those of somewhat mature age. B. C. W.

International Language and Science. Considerations on the Introduction of an International Language into Science. By Profs. L. Couturat, O. Jespersen, R. Lorenz, W. Ostwald, and L. Pfaundler. Translated by Prof. F. G. Donnan. Pp. ix+87. (London: Constable and Co., Ltd., 1910.) Price 2s. net.

Internaciona Matematikal Lexiko en Ido, Germana Angla, Franca e Italiana. by Dr. Louis Couturat. Pp. 36. (Jena: Gustav Fischer, 1910.) Price 1.50 marks.

THE first of these books is an English edition of a work the German edition of which was reviewed in NATURE for August 19, 1909. The translator is Prof. F. G. Donnan, of Liverpool University. The "Internaciona Matematikal Lexiko," by Dr. Louis Couturat, contains all the technical terms commonly used in mathematics. The language of the International Commission constitutes in many respects a great advance on its predecessors. If there is one feature that possibly calls for improvement, it is that the new language is not based on Latin as much as it might be, in view of the fact that Latin is taught in schools in every civilised country. By adopting the Latin vocabulary free from all unnecessary grammatical technicalities, the need of a new language could have largely been obviated. It is true that a large proportion of the words are taken from Latin, but there are exceptions, such as "lasta" for ultimate, "samcentra, sam-foka," and so forth, for concentric and confocal, "ringo" for annulus, and "helpanta" for auxiliary.

The Presentation of Reality. By Dr. Helen Wodehouse. Pp. x+163. (Cambridge: University Press, 1910.) Price 3s. net.

IN this little book Dr. Wodehouse (who is lecturer in philosophy in the University of Birmingham) attempts a description of knowledge from the point of view of a philosophical psychology. She avoids metaphysics as far as possible, but maintains that in all cognitive experience we come into immediate contact with objective reality, of the existence of which we have in experience an irrefutable witness, and that on all levels of cognition, sensuous or intellectual, this happens in the same way, namely, by the presentation of an object to a subject.

The author's metaphysical inclinations seem to be towards the school of Reid, while among recent writers her affinities are with Dr. James Ward, Dr. G. F. Stout, and Dr. A. Meinong. Bradley on the one hand, and James on the other, come in for acute criticism, Dr. Wodehouse believing strongly—as against the great pragmatist—that reality does not wait for our thinking to make it, though the discovery of reality does; that some discoveries can be made, and that it

is the duty of philosophers to go on trying to make them, with which, no doubt, both pragmatists and absolutists would agree. Indeed, "in spite of everything, this is presumably the real standpoint of all of us."

Lessons on Elementary Hygiene and Sanitation, with Special Reference to the Tropics. By W. T. Prout. Second edition, 1909. Pp. xx+159. (London: J. and A. Churchill, 1908.) Price 2s. 6d. net.

WE are not surprised that this little book has passed into a second edition. The plan of it is well conceived and the matter excellently written. It tells in the simplest language, with many appropriate comparisons which drive home the meaning, the structure of the body and its functions, how health may be safeguarded, and how disease is propagated. Disease germs, their mode of spread and entrance into the body, are explained, and the salient points with regard to the principal infective diseases are adequately considered. Being avowedly written for residents in the tropics, and in particular for those in Freetown, West Africa, diseases like malaria, cholera, plague, sleeping sickness, leprosy, &c., receive considerable attention, but otherwise the details given are equally applicable to the hygiene of any district.

Chapters on water supply and its purification, the dwelling and sewage removal, respiration and ventilation, diet and clothing are included, and render the book a complete popular exposition of the principles of hygiene. It is also well and sufficiently illustrated. R. T. H.

Aëroplane Patents. By Robt. M. Neilson. Pp. x+91. (London: Constable and Co., Ltd., 1910.) Price 4s. 6d. net.

THIS is a useful book, which may be recommended to all who are interested in the subject of aëronautics. It begins with thirteen pages of sound advice to inventors, and continues with a list and description of the various patents relating to heavier-than-air flying machines. The list does not profess to be complete or exhaustive, but it contains all the important patents and most of the minor ones are mentioned. The descriptions given are sufficient to explain the objects and claims made in each case.

The period covered by the list extends from 1860 to 1910, and perhaps the most interesting matter which it brings to our notice is the enormous increase in the number of patents relating to aëronautics taken out since 1907. From 1860 to 1906 the average number of patents was about six per year. In 1906 the number was 29; in 1907, 42; in 1908, 115; in 1909, 759; and in 1910 (for eight months), 412.

That but a small percentage of the patents should be of value is only what might be expected, but the total number is evidence of the attention which is being given to the subject.

Stray Leaves on Travel, Sport, Animals, and Kindred Subjects. By J. C. Walter. Pp. xii+295. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1910.) Price 5s. net.

THE ten chapters making up this book are for the most part extracts from the author's diaries written among the scenes described, and papers prepared for meetings of a natural history society.

The conversational style adopted makes reading easy, and the persevering reader will incidentally accumulate much useful information about the countries in which the author has travelled, and become acquainted with the habits of many animals which have aroused the author's interest. Mr. Walter's wanderings have by no means been confined to his own country; we have chapters dealing with his excursions in Egypt and Palestine, France, Switzerland, and Italy respectively. On each of his numerous journeys Mr. Walter was an industrious diarist.

1200 *Mining Examination Questions.* Arranged and compiled by G. L. Kerr. Pp. xxvii+111. (London: Crosby Lockwood and Son, 1911.) Price 2s. 6d. net.

THESE questions have been selected principally from the papers set at the examinations held in the different districts of Britain for managers' and under-managers' certificates. The volume also contains copies of ventilation plans set at these examinations, and suggestions to candidates who desire to qualify for mine managers' certificates.

To some of the questions answers have been given, but to the majority of them this has intentionally not been done. The compiler explains that the correct answer for any given question will vary somewhat according to the formula used, and in mining unfortunately no uniform set of formulæ has yet been accepted.

Chez les Français. Edited by H. Carter. With Exercises, by C. F. Shearson. Pp. vii+171+vii. (London: A. and C. Black, 1910.) Price 2s.

THIS well-selected collection of passages in French, from writers of recognised literary merit, dealing with France and French customs, should prove useful in classes where some progress has been made in the study of the language. The book should be particularly serviceable in connection with elementary geographical teaching.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Biological Inquiry into the Nature of Melanism in *Amphidasis betularia*, Linn.

IT is well known to entomologists that dark varieties of several species of moths have recently become increasingly common in many localities within the British Isles, and also that the dark forms are appearing in fresh districts.

It is very desirable and important to know whether the colour of these dark races of moths is protective or whether it has some other significance.

Before, however, any definite explanation of these phenomena can be attempted, it is necessary to have as complete a knowledge as possible of all the circumstances which are likely to have any influence on the species known to exhibit this melanic change. One significant point in connection with my inquiry concerns the resting habits of the moths which are subject to this melanic variation. For example, it is important to know whether the light-coloured moths (*i.e.* the peppered form of *Amphidasis betularia*) generally rest during the day on lichen-covered trunks of trees or any other light-coloured object, and also whether the dark insects (as the form Doubledayaria of *A. betularia*) select black tree trunks or other dark-coloured objects on which to rest.

Information of this nature can, however, be obtained only by the cooperation of very many entomologists, for the chance of obtaining sufficient evidence from the observations of one or two persons is very remote. I should therefore be extremely grateful if entomologists would assist me in collecting information regarding the resting habits of any of the undermentioned species belonging to the Geometræ which may have come under their notice:—

Amphidasis betularia (Peppered Moth).
Amphidasis prodromaria (Oak Beauty).
Odontoptera bidentata (Scalloped Hazel).
Phigalia pilosaria (Pale Brindled Beauty).
Boarmia repandata (Mottled Beauty).
Boarmia abietaria (Satin Carpet).
Boarmia rhomboidaria (Willow Beauty).
Gnophos obscurata (Annulet).
Hybernia progemmaria (Dotted Border).

Scheme of particulars :—

(1) State, if possible, the number of specimens of each variety (light or dark, &c.) of the above species that have been observed at rest, together with particulars as to the object upon which they were found, and also say whether they were conspicuous or well protected by their colour.

(2) State, if possible, whether the species is abundant, fairly common, or rare in the locality to which reference of the observation is made.

(3) If it is not possible to answer the foregoing questions, any other information concerning observations of a general character will be very acceptable.

All help received will be fully acknowledged on publication; and I would like here to express (as it has not yet been possible to publish anything upon the subject) my great indebtedness to those entomologists who have previously sent valuable information concerning the distribution, &c., of the various forms of *A. betularia* in their own particular localities in compliance with a former request.

The University, Manchester. H. S. LEIGH.

Protection from "White Ants" and other Pests.

IN a recent number of NATURE there was a note on the subject of ants in general and white ants in particular (they are not ants, but that does not matter, as they are "so called"), in which it is said that the Admiralty has decided in favour of "blue oil." Blue oil is the residue left in the distillation of mineral oils after the isolation of kerosine (called petroleum in England) and paraffin. I therefore venture to give you my experience in regard to the same and as to some other cognate matters.

Some twenty years ago I bought a cottage at Mittagong, about eighty miles from Sydney; it was furnished, and when I went there for a night I heard a continual rasping sound whilst in bed, and next morning, on examining the place, I found it was infested with white ants. They had eaten the pine lining in two rooms, as well as the uprights of a door.

I was then connected with a kerosine company, and immediately got a quantity of blue oil, which I had sprinkled all round the foundation of the house with a watering-can. The result is that the lining is in the same condition that it was twenty years ago. This is not an isolated instance, because during that time I have had much experience of "white ants," and have always found that they cannot work if they are cut off from connection with the ground, from which they get moisture, which is necessary for them, and they do not seem able to get through ground saturated with blue oil.

There is another matter to which I may refer in this letter. When I bought my present home, in 1882, I found it full of weeds and ants. I have got rid of both by extermination, and with the latter of aphis and almost entirely of scale insects. Of the former I have not seen one for the past fourteen or fifteen years. My first experience was with black aphis, by which the leaves of a nectarine tree were all curled up, whilst ants were continually running up and down the stem. I had read Sir John Lubbock's account of ants carrying the eggs of aphis to their nests, and I therefore shaved off the rough bark and chalked the stem for a foot or so, and the result was that the ants soon ceased to visit the tree, and we had a healthy tree and a fair crop of fruit. I may say that, so far as my observation goes, ants cannot climb up a chalked stem or post, as the chalk comes off with their feet and they fall down. I am not sure that this is the correct interpretation, as I have seen that if a broad chalk line is drawn round a meat-dish standing on a shelf the ants seldom get across it, and if they do it is only by some place being missed in chalking. They seem to leave a trace of formic acid behind them which guides the followers, and, combining with the calcium of the chalk, deprives them of their clue.

As to ants in general, I may say that after trying various ways to get rid of them I have come to an effectual method, that is, to find their nests and pour down each hole two ounces of a solution of cyanide of potassium. Two ounces per gallon is the strength I have used, but it might be weaker. The ants are not all killed by the first dose, for some are out foraging, and one cannot be certain of killing all the queens, but by giving them a dose once a week or a fortnight it is possible to get rid of them.

There is another matter I may mention. Some thirty-nine or forty years ago I observed an old shingle-roofed cottage at Maitland. It had two dormer windows, the sides of which had been painted white with white lead. The whole of the roof was rotten with fungoid growth except below the dormers, where the paint had been washed down by the rain, leaving a white streak, and there the shingles were nearly as good as they were when put on. It was therefore evident that white lead was inimical to fungoid vegetation.

When I came to my present home I had outside venetian blinds, and the "ladders" got quite rotten in three years, evidently by fungoid growths. In getting new ladders I steeped them in a solution of acetate of lead (6 ounces to the gallon), and they lasted for thirteen years, being by that time worn out by friction in moving them up and down. Acetate of lead is soon converted into white lead by atmospheric carbon dioxide. I have used the same process with a sheet surrounding a shower bath which in six months was black with "mould," and now it is in as good condition as it was ten years ago.

WILL. A. DIXON.

97 Pitt Street, Sydney, October 31.

January Meteors.

THE most noteworthy of the January meteor showers is that of the Quadrantids. Owing to the great northerly declination of the radiant, these meteors can be observed at any hour of the night, and being long-pathed they may, if fairly numerous, present quite a striking display. In 1911 the maximum will fall on the night of January 3, computed particulars of which and of other subsequent meteor showers are here summarised.

Epoch January 3, 11h. (G.M.T.), fourteenth order of magnitude. Principal maximum January 3, 12h. 30m.; secondary maximum January 3, 16h. 30m.

Epoch January 4, 13h. 30m., seventeenth order of magnitude. Principal maximum January 3, 12h. 40m.; secondary maximum January 3, 6h. 30m.

Epoch January 6, 22h., approximately sixth order of magnitude. Principal maximum January 5, 14h. 10m.; secondary maximum January 5, 2h. 45m.

Epoch January 6, 2h. 30m., fifteenth order of magnitude. Principal maximum January 7, 9h. 45m.; secondary maximum January 7, 7h.

Epoch January 11, 4h. 40m., eighteenth order of magnitude. Principal maximum January 12, 23h.; secondary maxima January 11, 4h. 40m., and January 12, 13h. 15m.

Epoch January 12, 19h., seventeenth order of magnitude. Principal maximum January 14, 9h. 20m.; secondary maximum January 14, 16h. 30m.

Epoch January 19, 17h., fifth order of magnitude. Principal maximum January 18, 7h. 30m.; secondary maximum January 19, 2h. 15m.

Epoch January 21, 8h. 30m., twelfth order of magnitude. Principal maximum January 22, 23h. 30m.; secondary maximum January 22, 18h. 30m.

The intensity of a meteoric epoch is inversely as its order of magnitude. Thus the heaviest maximum occurs on January 18, as it belongs to an epoch of the fifth order of magnitude, which is the highest of the month. Owing, however, to the times at which its maxima occur, and also to other circumstances, this epoch will not furnish so many meteors as the first two of the month, which have their principal maxima shortly after midnight on January 3.

Dublin. JOHN R. HENRY.

EXCAVATIONS IN CRETE.[1]

SWIMMING in the blue sea of the Gulf of Mirabello (well so named!), on the north coast of Crete, is a solitary isle, the name of which is beautiful in its Greek shape of Pseira, but by no means so lovely when translated into English, for ψεῖρα means "louse." The polite geographer Kiepert has in his map turned "Pseira" into "Psyra" (which is so much nicer), but Pseira, *Lausinsel*, is its name.

Photo.] [*R. B. Seager.*

FIG. 1.—Pseira, from Kavou i.

Seen from the west it reminds one of the Bass, but from the heights of the bridle-path leading over the cliffs from Kavousi to Tourloti, we see how low and insignificant it really is in comparison with the coast-hills; it looks little more than a long, low shoal. It is barren, and waterless, and no man lives there; only a few goats derive a precarious subsistence from the scrubby herbage which covers a portion of it; the rest is bare rock. Yet this unpromising place was the site, three thousand years ago, of a flourishing settlement of men, in which wealth existed and art was fostered.

Readers of NATURE will remember that some years ago Miss Boyd (the present Mrs. Hawes) excavated for the University of Pennsylvania an ancient Cretan town on the spot which bears the name of *Gournià*, on the mainland not far from Pseira; articles describing her work have appeared more than once in these columns. With her was working a young American archæologist, Mr. Richard B. Seager, who, after the close of the work at Gournià, excavated a settlement at Vasilikí, on the isthmus of Hierapetra, half-way between Gournià and Kavousi, which is opposite Pseira. The results of his work at Vasilikí were reviewed in NATURE of September 6, 1906. His next essay was the exploration of Pseira, where certain indications seemed to promise success in digging. Nor were these expectations disappointed. On the small tongue of land which forms the eastern side of the tiny cove which is the harbour of Pseira (a haven just large enough to hold a couple of caïques), were discovered the remains of an ancient town, with streets of houses descending steeply to the sea. It was a tiny place, though when it was made it was bigger than it seems now, for the land has sunk everywhere along this coast since the old Minoan times, and now the waves wash into the houses. All the ancient Cretan towns of the Bronze age seem to have been small, as was Gournià, judging by our standards, with narrow streets, some five feet broad at most, and cramped houses with tiny rooms.

But their small size was not the result of small ideas or lack of culture. In the ruined houses of these ancient towns have been found treasures of ancient art, of that most ancient art of Greece, the art of the Heroic age, which is older by a thousand years than the "Greek art" of the schools. And waterless, barren little Pseira has yielded objects of art finer than most of those found at Gournià, and hardly inferior to many of those discovered by Dr. Evans at Knossos (though, of course, in much less number). We may instance the relief fresco of the lady or

Photo.] [*H. K. Hall.*

FIG. 2.—The ancient town of Pseira, showing the excavations.

goddess published in plate v., and the vases in Fig. 9 and plate vii., of Mr. Seager's report on his excavations, which lies before us.

A cursory glance at these and the other illustrations of the report shows us that at Pseira the best traditions of Knossian art were followed, and it is evident

[1] "Excavations on the Island of Pseira, Crete." By Richard B. Seager. (University of Pennsylvania; the Museum; Anthropological Publications, vol. iii., No. 1.) Pp. 38+19 figures+9 plates. (Philadelphia: The University Museum, 1910.)

that the little island was really wealthier than Gournià, which at the time (about 1700–1400 B.C.) was probably the local provincial capital of the isthmus district. This wealth must have been due to seafaring trade, and probably to a great fishing industry, for agriculture there could be none on Pseira, even if in those days (as seems likely) there were water springs which now have dried up.

Then, about the end of the First Late Minoan Period (about 1500 B.C.), came a catastrophe. The town, which, like other settlements of the Cretan thalassocrats, even on the coast, was undefended by walls and open to attack, was taken, destroyed, and sacked by some unknown enemy. It never recovered, being only occupied for a short time during the Roman period.

To this disaster we owe, as Mr. Seager well points out, the preservation of so many objects of high interest. Gold, siver, and bronze were all looted and carried off; hence the comparative rarity of metal objects. But the fine pottery which is of so great interest to us now as evidence of the culture of its makers was unvalued by sea-robbers, and so, here, as elsewhere in ancient towns which have been destroyed by a catastrophe, we find this pottery and other remains of value to us exactly where it was left by the expelled or destroyed owners, or where the rage of the conqueror cast it forth. "On all sites the period of destruction is the one which leaves the richest harvest for the excavator. As long as a site is in continuous occupation the earlier deposits are only the refuse of breakage and objects which have ceased to be of service to their owners. They are thrown into rubbish-heaps and used as artificial fillings to make even floors over naturally uneven surfaces. Where, as at Pseira, the town was destroyed in the height of its prosperity, with no extensive later settlements to disturb its ruins, the finds are, of course, unusually rich" (p. 10).

I have no space for any critical discussion of technical points of archæology, but may say that Mr. Seager's description of his finds in this summary report is both able and interesting. The publication is well produced, its plates are admirable, and its line illustrations well and accurately drawn. It is a worthy addition to the series of anthropological publications of the Pennsylvania University Museum, of which it forms the first number in the third volume. Soon we hope to see a similar report on Mr. Seager's later and still more interesting discoveries at Mokhlos, another isle, east of Pseira, where tombs have yielded gold treasures like those of Troy, and as old. Mr. Seager is to be congratluated on his admirable contributions to the great work, important and useful alike to science and to art, which is being carried out by the excavators of ancient Crete. H. R. HALL.

THE LEAD GLAZE QUESTION.[1]

THE report referred to below is the outcome of the deliberations of a committee appointed by Lord Gladstone in May, 1908, to consider a question which has engaged the attention of the Home Office and Parliament for several years past, and has already been the subject of inquiry by several departmental committees. It is a matter of common knowledge that persons engaged in the making of earthenware and china are subjected to considerable risk to health from two main cases—dust and lead. The dust arises from the finely-divided silicious matter, mainly ground flint, employed in various stages and processes of ceramic manufacture; this when breathed gives rise to distressing bronchial and lung troubles, and in an aggravated form leads to the malady known as "potter's rot."

[1] Report of the Department Committee appointed to inquire into the Dangers attendant on the use of Lead and the Danger or Injury to Health arising from Dust and other Causes in the Manufacture of Earthenware and China and in the Processes incidental thereto, including the Making of Lithographic Transfers. Presented to both Houses of Parliament by Command of His Majesty. Vol. i. Report. Pp. vii+150. (London: H.M.S.O., 1910.) Price 1s. 5d.

The danger arising from dust may be largely obviated by the use of mechanical and other appliances whereby the operative is prevented from inhaling the dust-laden atmosphere. By the more general use of exhaust-fans or other suitable ventilating machinery, and by the employment of respirators, cases of "potter's rot" are less frequent now than formerly. At the same time much remains to be done by a more stringent application of these remedial measures. It was only in 1894 that the Home Office issued the first code of special rules dealing with dusty processes. The evil is patent and notorious; it is, however, not very satisfactory to be told that we must wait for the statistics of 1920–2 before we can estimate the real value of these special rules. If public opinion moved as fast on the dust problem as it has on the lead question, we should not have to wait ten or twelve years before this crying evil was absolutely stamped out, and "potter's rot" become as much a thing of the past as "phossy jaw."

It is, however, mainly to the dangers attendant on the use of lead in pottery manufacture that public sentiment has been roused, and it has been largely in deference to this feeling that the several departmental committees above alluded to have been appointed. It is only by "pegging away" in this manner that such amelioration as has been secured has been reached.

The pottery industry in this country is mainly centred in North Staffordshire. Of the 63,000 workers in the 550 factories scattered throughout the United Kingdom, 48,000 are employed in the 329 "potbanks" in the district known as the "Potteries." Owing to special circumstances, arising largely from local conditions of employment, no systematic attempts to grapple with the evil of lead poisoning have been made by the manufacturers as a body. Individual firms, with intelligent management, have succeeded in minimising the mischief, but the laxity of other firms has at times more than neutralised the benefits which have been secured by the more general adoption of the precautionary measure which common-sense seemed to indicate and experience has shown to be adequate. The manufacturers as a body have, in fact, been content to wait until outside pressure has forced them into action, mainly by rules and regulations issued by the Home Office, and based on the suggestions or recommendations of departmental committees appointed *ad hoc*.

The committee which has now reported has gone over much of the ground already traversed by its predecessors, or which occupied the attention of those engaged in the prolonged arbitration under Lord James, leading up to the special rules of December, 1903. But it cannot be said that any real progress has been made. Although it has been established that a large amount of earthenware can be made without the use of lead in any form, and even in the cases where lead must be used, it has been proved that the lead may be so combined that it is practically innocuous, the manufacturers as a body have hitherto resisted any attempt to prescribe a schedule of articles which should be made with leadless glaze, or to bind themselves to use glazes in which the lead is in an innocuous form. They, in fact, demand unrestricted liberty to use any materials they think necessary for their purposes. The loud cry of "foreign competition" is sufficient to drown the still, small voice of pity raised on behalf of the workers.

Now it is absolutely certain that under such conditions lead-poisoning in pottery manufacture will continue to occur. The leading manufacturers, through their counsel, in the course of the arbitration proceedings before Lord James of Hereford in 1903, promised the extirpation of lead-poisoning under the rules then proposed, but that promise has not been kept. On the contrary things are as bad as ever. That more might be done under the rules as they stand would seem to follow from the statistical information furnished by the committee. They examined into the record of the 550 potteries which have been placed under these special rules during the period 1904 to 1908, and they find that during these five years:—

5 potteries have been responsible for			75 cases
17	,,	,,	,,	119 ,,
151	,,	,,	,,	323 ,,
In all 173	,,	,,	,,	517 ,,

leaving 377 potteries out of the 550 in which no cases have occurred at all. In other words, 32 per cent. have an average of three cases every five years, while 68 per cent. are entirely free from the disease. In the 173 potteries in which the disease has occurred there are 4,800 workers as against some 2,000 in the other potteries. The conclusion would seem to be obvious. It is in certain relatively large works that the cases of lead-poisoning are most frequent, and this can only be due to bad management, imperfect supervision, or inadequate protective appliances.

During the period 1901–9, 865 cases of lead-poisoning in pottery workers were reported. Of these 788 arose from glaze processes, whereas only 51 were due to decorative processes. Lead glaze is therefore the main cause of the evil.

It cannot be said that the conclusions of the committee now reporting have tended in the slightest degree towards a solution of this grave evil. All the conditions to which lead-poisoning in ceramic manufacture is due are perfectly well known, but the committee was apparently unable or unwilling to make any definite suggestions as to remedies. The committee pleads that it was in a difficult position. The members of the committee representing the manufacturers were entirely opposed to any restriction in the use of raw lead; the representatives of the workers, seeing the comparatively harmless character of low-solubility glazes, would be glad to see them generally introduced, "but have to consider the grave risk of loss of employment which any dislocation of the industry due to their introduction might entail." *Might,* not would. Taking the question of glazes as a whole, two facts, says the committee, are beyond dispute:—

"In the first place, the danger to the workers of handling raw lead is very real; in the second, it is evident that however unsuitable leadless and low solubility glazes may be for certain classes of ware, there is a considerable quantity made for which they are quite satisfactory."

But the members of the committee are unable to make up their minds what classes of ware are represented by this "considerable quantity," although the facts were before them. They think, however,

"that every inducement and encouragement should be given to the manufacturers both to persevere with their experiments in search of satisfactory and low-solubility glazes, and to introduce them whenever possible."

Also efforts should be made to arouse the interest of purchasers in the question. The members think "it was established that pottery made with leadless and low-solubility glazes can be obtained of excellent quality," and they "consider that the desirability of insisting on being supplied with such ware should be brought home to the public at large." Lastly, they are of opinion that—

"the observance of the special rules has been far from satisfactory. In the past many of the manufacturers do not appear to have regarded it as incumbent on them personally to insist upon it; they have left the initiative to the factory inspectors, and in future they should be made to realise that they are themselves responsible."

The committee obviously had not the courage of its convictions. It is difficult to imagine any more feeble or inconclusive "conclusions." No constructive action seemed to be possible to it; its only policy was that of *laissez-faire*. The net upshot of the inquiry is that the whole position is not one whit ameliorated; the operatives apparently are still to remain the victims of lax surveillance or of indifference, and of official non-interference.

The matter, however, cannot be allowed to rest in this position. If the manufacturers' claim for unrestricted liberty to use such dangerous materials as they please is to be allowed, they must be made to feel the responsibility they therby incur by far more stringent measures than have hitherto been brought to bear upon them.

THE NEW ENCYCLOPÆDIA OF SPORT.[1]

WHETHER by design or by accident, the new edition of this work has appeared at an opportune time, since the success of the Vienna Exhibition has attracted an even more than ordinary amount of attention to sports and pastimes of all sorts during the year now rapidly coming to a close. Those who

Photo.] [*W. S. Berridge.*

Himalayan Tahr. From "The Encyclopædia of Sport."

possess the first volume of the original edition will find, on comparing it with its successor, a great change in regard to much of the subject-matter, aviation having been practically created since the date of the appearance of the first edition, while during the same period motors have come to the front as a means of communication, and everything in connection

[1] "The Encyclopædia of Sport and Games." Edited by the Earl of Suffolk and Berkshire. New and enlarged edition. Vol. i., A to Cricket. Pp. viii+496. (London: W. Heinemann, 1910.) Price, 10*s.* 6*d.* net at home; 12*s.* 6*d.* net abroad.

with automobiles has been revolutionised. So far as I am capable of judging, these articles, as well as those devoted to archery, athletics, cricket, &c., are thoroughly up to date, and, like the rest of the volume, admirably illustrated.

On turning, however, to the articles on big game and big game shooting, I notice that there is a considerable amount of repetition and overlapping, while, worse still, one and the same species of animal is in several instances mentioned in different places under different names. In the case of the reindeer or caribou, for example, the scientific name of the species is given on p. 264 as *Rangifer tarandus*, on p. 399 as *C.* (=*Cervus*) *tarandus*, and on p. 401 as *Tarandus rangifer*. Take again the case of the Indian gazelle (*Gazella bennetti*), which is figured, quite unnecessarily, in three different places. The first figure, p. 75, bears the legend "Ravine Deer"—a common sportsman's name—while it is alluded to in the text as the "Chinkara"; on p. 256 the illustration is lettered "Indian Gazelle," while on p. 412 the same figure reappears under the designation "Chickara." Again, the West African dwarf buffalo is designated *Bos caffer nanus* on p. 248, and *Bos pumilus* on p. 319.

These eccentricities in nomenclature are, however, by no means all the defects in the articles under consideration. The chita, or hunting leopard, for example, in addition to being styled *Cynaelurus jubatus* on p. 408, and *Felis jubata* two pages later, is stated on the former to be nearly related to the leopard; and on p. 410, the Indian spotted deer, or chital, is asserted to be a near ally of the fallow deer, despite the fact that the one wears its spotted livery all the year round and the other only in summer. Worse than all, we find on p. 250 a photograph described as that of the western tur (*Capra caucasica*), whereas it is really of the same individual as that depicted on p. 252, under its proper title of tahr (*Hemitragus jemlaicus*).

An error of another kind appears in the first article under the heading bison, which is devoted solely to the American representative of the group, whereas it should have commenced with the European species, which is the bison *par excellence*, the American animal having only a kind of courtesy right to the title.

These and others errors are due, in the first place, to what I regard as the pernicious principle of putting men of different opinions, and in many cases of very different degrees of knowledge, to write on the same subject or branches thereof, and in the second place to the lack of a competent editor to revise and correlate the zoological articles, and thus prevent useless and irritating repetition.

While fully appreciating the value of the work as a whole—which is really a wonderful enterprise—the above and other errors in the big game portion are much to be deplored, more especially as the articles are intended for the use of those who are not professed naturalists.

R. L.

WESTERN CHINA.[1]

MR. ARCHIBALD LITTLE'S work, the result of fifty years spent in western China, forms a valuable contribution to our knowledge of that vast region. The volume before us is invested with special interest, as it is the remnant of the labour to which he devoted the greater part of his life. He was at heart an explorer, although in business as a merchant in Chung-keng, much of his time was spent in difficult and dangerous expeditions, which he carried out so successfully as to establish his fame, not only as an intrepid traveller, but as an authority on the western provinces of the empire. He was an exception to the majority of the foreign merchants one meets in China in his having acquired a

FIG. 1.—The Hua-Hua Lo at Wuchang, opposite Hankow: one of the most beautiful pavilions in China, unfortunately destroyed by fire. From "Gleanings from Fifty Years in China."

[1] "Gleanings from Fifty Years in China." By the late A. Little. Revised by Mrs. A. Little. Pp. xvii+330. (London: Sampson Low, Marston and Co., Ltd., 1910.) Price 7s. 6d. net.

working knowledge of the language, which proved of service to him in his travels and intercourse with the natives, and in obtaining trustworthy information.

The present volume, unlike its predecessors, is made up of a series of desultory notes or essays written at intervals during his fifty years in Chung-keng, the majority having already appeared in some published form, while the remainder are printed for the first time. Taken together, they form an interesting addition to the author's well-known work, and are published as they were written, no attempt being made to edit or rearrange the material. It is best so, as they are characteristic of the author, who won his way to the hearts of the alien folks among whom he lived and wandered in security for so many years, a people who would fain see the last of the average foreigner, whose aggressive commercialism they do not love.

In his discussion of foreign trade with China the author traverses familiar ground, but he affords some insight into Chinese diplomatic delays in his account of the years spent in fruitless endeavour before Chung-keng was thrown open as a treaty port. Mr. Little was the first to take a steamer through the gorges of the Upper Yangtse, a feat so daring and hazardous as to prove what had been foreseen, that the route was impossible for regular steam traffic.

FIG. 2.—A quiet reach on the Upper Yangtse. From "Gleanings from Fifty Years in China."

In his historical notes on the provinces from Marco Polo's time, who was the first to describe the region, he states that an interval of some 600 years elapsed before Abbé Huc gave some further account of the country in 1844. He overlooks the claims of Fradelli, Regis, and Bonjour, who, early in the seventeenth century, surveyed and described the western provinces of China, their products, and people.

We can do little more than name some of the other subjects dealt with in the volume—the possible partition of China, China's Christian missions, an essay in which the views expressed may not meet with the approval of those engaged in the work, although he pays a just tribute to the workers as "the promoters of all good in the advance made by China in the past fifty years."

The concluding chapters on the Chinese drama, with examples of native plays, and on Confucianism are new, and sustain the scholarly reputation of the author. A series of excellent photographs add to the attraction of the volume. J. T.

THE CALORIMETRY OF MAN.[1]

A GREAT deal has been said previously as to the general excellence of the methods and apparatus developed in connection with the "respiratory calorimeter" now in use in the Nutrition Laboratory in Boston. That they are original and are carried to a unique degree of perfection, that they have been utilised in the solution of very interesting problems. All this is well known, and will be found frequently dealt with by the authors of the publication referred to below. Gratitude has been freely expressed on these points.

In this recent publication the authors, experienced investigators advantageously equipped for the purpose, have set themselves the task of laying a base line for further calorimetric research. They will receive the thanks of every interested technical observer for the splendid series of data which they have compiled, but they have overhauled them in a manner open to some criticism.

To develop this statement let us take one set of their facts, namely, that the oxygen consumption and heat production of the human being vary during periods of sleep within wide limits when assessed per man, or per kilo of man, or per square metre of the surface of man. Of these three forms of assessment, the last is the most interesting since the loss of heat, and therefore the oxygen consumption and heat production by which it is compensated, is largely conditioned by extent of surface. Now it is of some importance that no surface measurements have been made and that the estimations of surface are really derived from the measurements of weight. The authors refer to this point with some expression of regret, and a promise of contributory data, again of an indirect kind, in future. It would, however, have been of far greater interest had they dealt soundly with their data of height and weight in such a way as to show with unmistakable clearness that no probable corrections in their surface estimations will account for the differences in heat loss observed. A clear statement that they had found variations not accounted for, *and never likely to be accounted for*, by variations in surface would have been of substantial value.

That this end might have been met by an adequate comparison of the measured heights and weights of their "tall lean men, tall men, short fat men, short men," with average anthropometric data, there can be no doubt whatever. Thus let us take the particular instance of the individual giving the minimum heat loss per man, or per kilo, or per square metre of the surface of man, as compared with the seventeen other individuals whose fortunes can be followed through most of the tabulated statements. His height may best be described as the cube root of his

[1] "The Metabolism and Energy Transformations of Healthy Man during Rest." By F. G. Benedict and T. M. Carpenter. Pp. viii+255. (Carnegie Institution of Washington, 1910.)

weight multiplied by 4·5. Armed with a convenient table of cube roots and plenteously available data, it will be found that this man is a departure from the average, but a departure in the opposite direction to that which would promise the concealment of much weight under a partially spherical and disproportionally small surface. In this country at least the average height of the youth from eight years of age to eighteen is $4·3\sqrt[3]{W}$, whereas the stouter child and adult above and below these ages is liable to possess smaller heights, such as 4·2 to $3·7\sqrt[3]{W}$.

So far is this man's rate of heat-loss per estimated square metre of surface below the average, and so unlikely is it that direct measurements of his surface will lead to any compensatory change in the statements such as would bring it near to the average, that it might have been of value to direct special attention to his indisputable peculiarity. Had this been done, another peculiarity of his might perhaps have been brought to mind and have been found of interest, namely, that he is a veteran *habitué* of the calorimeter. It may be suggested, indeed, that this is the important fact inasmuch as it enabled him to sleep amidst these peculiar surroundings and modified atmosphere with unusual unconcern. That unconcern is truly a factor of some importance may perhaps be gathered from a consideration of the unexplained greater evaporation of water from the surfaces of the few women bold enough to enter the calorimeter. It might be suggested that there is no mystery in the fact that these ladies perspired unduly.

It is almost certain that this particular case might legitimately be used to illustrate the statement that sleep, like scientific literature, is sometimes profound although often not so. It is indeed a well-known fact that the excitability of the nervous system during sleep is a very variable value, and it is extremely probable that its variations are attended with changes in the "tone" of the skeletal musculature, and therefore with modifications in the quantity of concurrent metabolism. Once take this point of view, which is apparently not dealt with by the authors, who describe all alike as being in profound sleep, and it will, on sound grounds, be found that there is not one of these recorded cases that does not require some consideration in these terms. Thus it will be found that every individual with a metabolism during sleep that is below the average value by more than 5 per cent., awakes to a metabolism increased by from 26 to 63 per cent., whereas every individual with a metabolism in sleep greater than the average by more than 5 per cent. awakes to a smaller increase varying from 10 to 22 per cent. It is necessary to suggest that the one set awake to a relatively much greater increase of metabolism because they awake from a more profound state of slumber. Nor is the suggestion the less necessary when it is discovered that although several not infrequent visitors to the calorimeter are found on either side of the average, yet the initials of the best-known *habitués* are found in the heavy slumber class and those of certain restless probationers in the list of light sleepers.

J. S. MACDONALD.

NOTES.

IN a four-column article which appeared in the *Times* of December 22, the outbreak of plague in East Anglia, and particularly the rat-infection in the locality, is dealt with ably and exhaustively. The writer of the article points out that no adequate measures have yet been taken to deal with the situation, and urges that it is one of national importance and for direct Government intervention. It is suggested that a sum of 10,000*l*. at the very least is required to prosecute the necessary inquiries and investigations, and that there is immediate necessity for expert inquiry under Government control and at Government expense. Compared with the issues involved, the expenditure of such a sum, or even one many times larger, need not be considered, and the course of action recommended will commend itself to those who have a real knowledge of plague, and it is to be hoped that the authorities will speedily take in hand an organised scientific inquiry into the outbreak of plague in England and the remedy for its control. Similar views in outline were expressed in the article on "Plague" which appeared in NATURE of the same date (December 22, p. 237).

THE appalling loss of life associated with the terrible colliery disaster at the Yard Mine of the Hulton Colliery Co. at Bolton, Lancashire, has again emphasised the desirability of perfecting, so far as is practicable, the warning of approaching danger. The explosion, which occurred shortly before 8 a.m. on Wednesday, December 21, resulted in the loss of about 350 lives. The *Times* of December 22 says the disaster followed immediately upon a colliery warning, which appeared on Monday in newspapers circulating in various mining districts, and the warning was said to be in continuation of one which had been circulated a week earlier. Such warnings are not, however, issued by the Meteorological Office. With the advance made in recent years in our knowledge of weather changes, it seems desirable to determine the atmospheric conditions under which explosions generally occur, and, if possible, to place the warnings of approaching danger on a scientific basis and to make some public authority responsible for the issue of such warnings. The weather chart for 7 a.m. December 21 issued by the Meteorological Office is of quite a common type, and is representative of many such occurrences in the course of an English winter. A region of low barometer was situated to the south of Iceland, and a region of high barometer was situated over Germany. The barometer at this time was fairly steady at about 29·95 inches over Lancashire. Examining the atmospheric conditions under which fifteen of the greatest colliery disasters of recent years occurred, between the years 1880 and 1910, there is a preponderance of explosions with a high barometer, and about the time that the central area of an anticyclone is situated in the neighbourhood. There are, however, marked exceptions to this, and the disaster near Wigan on August 18, 1909, occurred when an area of low barometer readings was centred close by. Irrespective of the absolute height of the barometer, the instances examined seem to occur about equally with a rising and a falling barometer.

A BILL to make Paris official time coincide with Greenwich time was presented to the French Senate on December 21. The Bill was passed by the Chamber of Deputies several years ago, and has been approved by the senate committee and by the Cabinet, so that in all probability it will become law. Paris time is 9m. 21s. ahead of Greenwich time; and upon the day prescribed by the law, the clocks indicating official time in France will be put back by that amount. By the adoption of the change, France will be brought into the international system of Standard Time reckoning which is now followed in most civilised countries. On this system, the hour of each successive fifteen degrees of longitude, reckoning from the Greenwich meridian, is used for the Standard Time; hence the difference in time in passing from one zone to another is always an exact number of hours.

IT was announced a short time ago that a new zoological garden in course of construction by Mr. Carl Hagenbeck in the grounds of the Villa Borghese, Rome,

would probably be opened on January 1. The grounds, which comprise twenty-eight acres, lie outside the old walls to the northward of the city, and it is stated that more than 40,000*l.* has been already spent on them, while the animals, some 1400 in number, represent another 10,000*l.* As at Stellingen, cages have been to a great extent dispensed with, deep ditches and scarped cliffs serving to confine the animals, which thus appear to be at liberty.

THE Zoological Society of London has elected the following corresponding members:—Mr. Roosevelt, ex-President of the United States; Mr. B. Basu, Calcutta; Mr. J. M. Doctor, Bombay; Dr. R. Dohrn, Naples; Prof. Ludwig von Graff, Graz University; Mr. W. H. Osgood, Washington, U.S.A.; Mr. H. Pam, Caracas; and Mr. R. B. Woosnam, Nairobi. Prof. E. Lönnberg, Stockholm, and Mr. S. H. Scudder, Cambridge, Mass., U.S.A., have been elected foreign members of the society.

WE learn from the *Chemist and Druggist* that the branch laboratories of the Pasteur Institute of Paris, at Garches, near St. Cloud, which are specially used for the preparation of anti-diphtheric and other serums, took fire a few days ago, and damage to the extent of 4000*l.* was done.

THE International Horticultural Exhibition which is to be held in the Chelsea Hospital grounds at the end of May, 1912, promises to have considerable scientific interest. There has only been one show of this nature in Great Britain, namely, that of 1866, which was held at South Kensington. Although the 1866 Exhibition was, in the end, a magnificent success, it very nearly proved disastrous to those responsible for the finances. The ultimate success was obtained by the committee prolonging the period the exhibition was open for public inspection, and the balance which resulted from this policy was devoted partly to the purchase of the Lindley library, at present housed in the Royal Horticultural Society's Hall at Westminster, and partly to making a donation to the funds of the Gardeners' Royal Benevolent Institution. In connection with the exhibition there was held an International Congress, and a valuable report of the proceedings was printed which is still a lasting record of the work and interest that were freely given by the horticulturists of that day. In 1912 a similar congress will take place, and subjects of international importance to the horticultural industry will be discussed in the presence of representatives from most of the European countries, America, and our own colonies. It is expected that the congress will consider the question of the regulation of insect pests and fungus diseases, and the effects of the prohibition of the importation of certain plants to certain countries, for instance, by the Phylloxera laws in the wine-producing countries. Certain other questions suggest themselves as ripe for discussion; for example, the improvements which have been effected in plants in recent years, the different methods by which those improvements have been obtained, and horticultural education, with special reference to the methods of training young horticulturists in this country and on the Continent of Europe and in America. A committee largely composed of scientific men has been appointed specially to promote the congress and a scientific section of the exhibition. The horticultural show itself is expected to be the largest ever held in this or any other country. There are already 431 competitive classes, and many of these are of scientific interest, but we must reserve any further remarks for a future occasion. Copies of the schedule can be obtained from Mr. Edward White, 7 Victoria Street, Westminster.

MR. J. GRAY contributes to the December number of *Knowledge* an article on the measurement of perseveration and its value as an index of mental character. In point of fact, Mr. Gray does not measure perseveration, but the speed at which rapid flashes of colour just succeed in extinguishing flicker in various subjects. He assumes that the individual differences with which he meets are due to differences in the persistence of colour sensations, and that "this persistence . . . is identical, or very closely related, to a quality of mind which the psychologists call Perseveration." The experimental facts which the paper contains are two, viz. that flicker disappears more readily in women than in men, and perhaps more readily in dark-haired than in light-haired persons. The nature of these differences awaits careful psychological investigation.

IN the *Revue générale des Sciences* for October 15 and 30 Prof. Marinesco, of the University of Bucharest, has given an interesting summary of recent investigations upon the anatomical localisation of the human cerebral cortex, and more especially of the distinctive cytological characters of each of the multitude of areas into which the pallium of the brain can now be subdivided. His descriptions are elucidated by a series of twenty-seven drawings exhibiting a wealth of intricate detail. The articles are essentially a digest of the work accomplished by others, and especially of the classical researches of Oskar and Cecilie Vogt and Karl Brodmann. Although Prof. Marinesco's citations of the results and the opinions expressed by other anatomists are not always exact, on the whole his summary will be useful to those who are unable to find time to read the voluminous literature upon which it is based.

THE Journal of the Quekett Microscopical Club for November (ser. 2, vol. xi., No. 67) contains a critical paper on the classification of the Bdelloid Rotifera which should be of great value to students of this difficult group. The same number contains an interesting echo of the British Association's visit to South Africa in 1905 in the description, by Prof. G. S. West, of a remarkable new species of Volvox collected by Mr. Rousselet in Rhodesia. The adult colonies are about 1 mm. in diameter, and may contain more than 50,000 cells. Another paper also deals with the microscopic fresh-water fauna of Africa, being a contribution to the list of Hydrachnidæ found in the East African lakes, by Mr. Charles W. Soar. The material upon which this paper is based was collected during the third Tanganyika expedition conducted by Dr. W. A. Cunnington.

IN the *Centralblatt für Mineralogie, Geologie u. Paläontologie* for 1906, p. 450, Dr. O. Abel founded a new genus and species of bird (*Alabamornis gigantea*) on two bones from the Alabama Eocene, regarded by Dr. Lucas as the pelvis of a Zeuglodon, these bones being described as coracoids of the bird. Dr. Lucas wishes to state that there is no doubt whatever as to the correctness of his original determination, and that the bones in question have been mounted in their proper position in the Zeuglodon skeleton which is now exhibited in the U.S. National Museum. "Alabamornis" must accordingly be deleted from the list of fossil bird genera.

DR. F. A. LUCAS writes to say that the "Open Letter" of the Campfire Club on the fur-seals of the Pribilows, which was referred to in NATURE some months ago, contains several misstatements, more especially the assertion attributed to the authorities that unless 95 per cent. of the males were annually killed the herd could not increase. In the Recommendations of the Advisory Board, of which

Mr. Lucas has enclosed a copy, the statement is "that not more than 95 per cent. of the three-year-old male seals be killed in any one year," which is, of course, a very different matter. Mr. Lucas adds that all male fur-seals over a certain size are not killed, but left to grow up, and that under the rules in force for the last five years the number of adult males has steadily increased, while the females have as steadily decreased, and will doubtless continue to do so if pelagic sealing be not stopped.

In a paper on animals in Glen Garry Forest, published in vol. vi., part iii., of the Transactions of the Edinburgh Field Naturalists' and Microscopical Society, Mr. Symington Grieve states that whereas half a century ago the sea-eagle was far more numerous in Scotland than the golden eagle, at the present time precisely the opposite of this is the case. The golden eagle, owing to the protection afforded to it by landowners, is increasing in numbers throughout the Highlands in suitable districts. On the other hand the sea-eagle, which formerly abounded on the cliffs of the west coast, has nearly disappeared, and in the author's opinion, in default of more efficient protection than it at present receives, will cease to breed in Britain within a few years. Mr. Grieve is also of opinion that the wild cat is on the increase in Scotland, owing to the instructions issued by proprietors and factors for its preservation.

In an article on the spawn and larva of the salamander *Amblystoma jeffersonianum*, published in the *American Naturalist* for December, Prof. W. H. Piersol directs attention to the low vitality of many of the eggs. Although no accurate census has been taken, it is estimated that under natural conditions three-fourths of the eggs do not live to commence gastrulation, and the same proportion of loss occurs in spawn kept in the laboratory. The egg does not die as a whole, but while some cells perish at an early period, others develop to a certain stage, only to die later. These dead eggs imbibe water and become larger than the rest, and in the natural condition become infested with a fungus. Since, however, this fungus does not make its appearance in spawn reared in the laboratory, it is manifest that the mortality is due to some other cause. On the other hand the spawn of the allied *A. punctatum*, both in the natural condition and in the laboratory, suffers practically no loss.

The Live Stock Journal Almanac for 1911 contains the usual amount of valuable information regarding horses and pedigree stock of all kinds for 1910, together with a number of articles on subjects of current interest by various specialists. Sir Walter Gilbey, for instance, discusses the effect of the rapid increase of motor vehicles on the prices of horses, and finds that although fewer horses are required in this country than was the case ten years ago, yet prices in all classes are fully up to their old level. This affords evidence that the supply has fallen *pari passu* with the demand, and this, from a military point of view, is a serious matter. On the other hand, the demand for shire horses is fully maintained. In another article Lord William Cecil directs attention to the value of our mountain and moorland breeds of ponies, on account of their stamina and hardiness, and advocates that Government should take into consideration the advisability of breeding a serviceable class of horse from pony mares. In an article on the connection between the various breeds of British cattle and the nature of the soil on which they are reared, Mr. P. McConnell revives the theory that the red colour of Herefords is connected with the red rocks of their native county. He forgets, however, to add that the Sussex breed is also red. Apparently he also believes that white park cattle are an aboriginally wild stock.

Dr. Guido Sala (*Mem. R. Ist. Lombardo Sc. e Lettere, Classe Sc.*, xxi., fasc. iv.) has published some interesting observations on the cells of the ciliary ganglion. In the human fœtus of six or seven months the cells are comparatively simple; they have few superficial prolongations (each ending in a bulbous enlargement), and a pericellular network is seldom present. At the time of birth the cells and their processes are larger, and six or seven months later loop-like outgrowths of the cell begin to appear, and later become more numerous, larger, and more complex. In adults there is a complex pericellular network of fine deeply staining fibrils, which completely envelops the cell, and there is often a spiral fibril round the axone. In old persons the cells exhibit modifications and assume almost the aspect of embryonic elements, and the protoplasmic processes of the cell are, for the most part, short and thick. In the same memoirs (fasc. iii.) Prof. Livini gives some notes on the development of the trachea in the chick. In embryos of about ninety-four hours' incubation the lower end of the trachea and the origins of the bronchi become narrowed and then occluded, but the lumen is restored before the one hundred and eighteenth hour of incubation. A little later the greater part of the trachea becomes similarly narrowed and temporarily closed.

Among thirty-one forms of lichen collected by Ir. M. Shegolef in the Jugjur chain (Stanovoi), *Umbilicaria caroliniana* and *Usnea cavernosa* are of special interest, as the former has been previously reported only from America and the latter only from America and India (Bulletin of the Imperial Academy of Sciences of St. Petersburg, No. 7, 1910). *U. cavernosa* seems to be widely distributed in eastern Siberia, for it is abundantly represented in Shegolef's collection.

Among ostracoda collected by D. Pedashenko in Issyk-kul is *Herpetocyprella mongolica*, of a new genus which resembles Candona and Eucandona in the absence of swimming bristles to the second pair of antennæ, but is very different in many other respects (*Travaux de la Soc. Imp. des Naturalistes de St. Pétersbourg*, vol. xxix., fasc. 2, part i.). Other new species are *Cypricercus mongolicus* and *Cytheridea pedaschenkoi*.

At the annual meeting of the Lancashire and Cheshire Entomological Society, held in Liverpool on December 19, Mr. R. Newstead, of the Liverpool School of Tropical Medicine, delivered his vice-presidential address on "Some Morphological Characters of the Genus Glossina." He stated that he has made a careful examination of the armature of the males of all the hitherto described species of the genus Glossina, and it has not only revealed some very striking morphological characters, but has led to the discovery of three hitherto undescribed species:—*Glossina submorsitans*, Newst.; *G. brevipalpis*, Newst.; and *G. fuscipes*, Newst.; and the re-establishment of Bigot's *G. grossa*. The scheme of classification adopted is based entirely upon the taxonomic characters of the male armature, which are the true and almost only natural anatomical elements that can at present be found in these insects. Mr. Newstead has found that the species fall into three striking and distinct groups, each being separated by very trenchant characters. The groups are:—(1) The *fusca* group, including the four largest species of the genus: *G. fusca*, Walker; *G. grossa*, Bigot, which have a western distribution; *G. longipennis*, Corti;

and *G. brevipalpis*, Newstead. (2) The *palpalis* group, to which belong the species: *G. palpalis*, Rob.-Desv.; *G. tachinoides*, Westwood; *G. fuscipes*, Newstead; and *G. pallicera*, Bigot. (3) The *morsitans* group, comprising *G. morsitans*, Westwood; *G. submorsitans*, Newstead; and *G. longipalpis*, Wiedemann. In these three groups forms occur which are so widely different as to lead one to assume, without taking the other external features into consideration, that they represent three distinct genera. Certain it is that these insects illustrate one fundamental principle of evolution, namely, that they have attained great development of one set of morphological characters, and have retained others apparently of an ancestral type.

THE difficult question whether acquired characters can be inherited is discussed by Dr. Hugo Fischer in the issue of *Naturwissenschaftliche Wochenschrift* for November 20 and the following number. Examples among unicellular organisms are accepted in the cases of the sporeless races of fission fungi and the colourless variety of *Micrococcus prodigiosus*; also the chromatic modifications of Oscillaria and the physiological varieties of numerous Uredineæ and Ustilagineæ are cited as good instances. Amongst animals, the author notes the experiments of E. Fischer and others, who produced more than transitory changes of colour in butterflies by subjecting the pupæ to abnormally low temperatures, and Kammerer's results with salamanders. In the case of flowering plants, the author holds that the Alpine forms of larch and pine and Wettstein's seasonal forms of Euphrasia and Gentiana are not definite examples, but admits the races of maize produced by Blaringhem and the modified type of Sempervivum raised by Klebs. The essential factor appears to be a disturbance of the metabolism.

A COPY of the annual report for 1909, dealing with technological museums, has been published by the Technical Education Branch of the Department of Public Instruction of New South Wales. The report is an excellent record of steady progress. A considerable number of exhibits were added to the collections during the year. The display of polished marbles and building stones of New South Wales in the museum at Sydney has been largely added to, and the whole now makes a fine exhibit. For comparative purposes, slabs of the principal foreign marbles have been displayed upon the walls in an adjoining court. To increase the available knowledge of the constructive value of the building stones, a special collection was obtained from various parts of the State, and prepared for testing at a 100-ton machine. Fire and water tests upon specially prepared cubes were next undertaken upon the sandstones, trachytes, marbles, and granites. The location of deposits of building and ornamental stones occurring in the area included in the Federal capital site was determined, and specimens of these materials procured. The data obtained, together with a specially constructed map, were published as an appendix to the second edition of the museum's work on the "Building and Ornamental Stones of New South Wales." The public-school teachers of the district take advantage of the facilities offered by the museum in the furtherance of nature studies; 1567 specimens were identified for teachers during the year, not including those brought to the museum by teachers and pupils; 865 specimens were supplied from duplicate collections to assist the teachers in the formation of school museums. Specimens were identified and classified for a large number of schools throughout New South Wales.

MRS. M. OGILVIE-GORDON continues her studies of the Triassic masses above the Grödental, in Tyrol, in the *Verhandlungen der k.k. geol. Reichsanstalt* for 1910 (pp. 219 and 290). In 1908 she visited the Boégipfel region with Prof. Rothpletz and Herr von Klebelsberg, and verified the overthrust of Raibl beds on Dachstein dolomite. Neocomian strata were found resting on Jurassic north and south of the Eisseespitze; these lie below the overthrust. The sections of the Boé and Jägerschart masses show remarkable discordances due to thrusting, even among the Jurassic strata, and the Upper Triassic beds climb up boldly on the crests. Similar overthrusting has been studied by the author in the Sella and Langkofel area (Trans. Edinburgh Geological Society, 1909–10). In the second paper in the *Verhandlungen* the discovery of fossiliferous Cassian beds is recorded from under the Burgstall, a part of the Schlern mass where a dolomitic and contemporary facies was believed to exist. The dolomite on this level farther west is attributed by the author to the occurrence of an overthrust, whereby the Cassian horizon is brought above a wedge of the Schlern dolomite, which properly should overlie it, as it is seen to do on the Gamsteig and the Burgstall.

THE *Geologische Rundschau* (Leipzig: Engelmann), which was recently started as a journal of general geology, continues on the broad lines laid down by its originating society. Prof. Steinmann, for instance, describes and illustrates in parts ii. and iii. the structure of the Cordillera of South America. M. Semper summarises seventy papers on the "Klimaproblem der Vorzeit," a labour that will surely rejoice his fellow-members. P. Wagner furnishes a list of 127 German works and papers bearing on geological teaching in schools and on the treatment of geology so as to promote interest and observation. His introductory essay of sixteen pages reminds us that the main object of the *Rundschau* is to bring the geological features of Germany and Austria to the front in public education. It is clear from his review that there is already a healthy movement to draw even scholastic mineralogy out of the old grooves of dry description. In part iii. W. Meigen reviews recent work on the origin of dolomite, and J. J. Sederholm discusses twenty-three papers on the pre-Cambrian rocks of Fennoscandia. E. Dacqué deals with the Jurassic strata formed by transgression on the "Lemurian continent," that is, in the region between New Zealand, East Africa, and India. In part v. J. Koenigsberger discusses the earth's age, and F. Pockels the bearing of earthquake research on the nature of the earth's interior. It is clear that these reviews of geological progress, written by specialists, make the *Geologische Rundschau* a very welcome addition in all libraries of a scientific character, as well as in many private homes.

THE Geographical Pictures published by Messrs. A. and C. Black for use in schools furnish selected views of typical land features for study. Twelve of these, illustrating various forms of valleys, have just been issued in Series x. as half-tone prints of selected photographs, about 16×12 cm. Notes accompany them suggesting various problems for study. A reference to the contoured map-sheet on which the feature is represented would further enhance their educative value.

COPIES of the Tide Tables issued by the Canadian Government for the Pacific and the eastern coasts of Canada for the year 1911 have been received. For the former, tide tables are given for six stations, and from these the tides at numerous stations can be determined. The results given are largely based on the observations of 1909, when twenty recording gauges were in simultaneous operation

throughout British Columbia; besides these, however, observations for six years are available at Sand Heads station, and for shorter periods at the others. On the eastern coast longer periods are available, and the tables for Quebec are based upon observations extending over thirteen years. It is claimed that the tables for Quebec, Father Point, Halifax, and St. John are now superior to those of any other harbour on the Atlantic coast of North America.

WE have just received Water Supply Papers Nos. 245, 247, 250, 251, and 237, 239, published by the United States Geological Survey, in addition to the papers of the same series referred to elsewhere (p. 283). The first four papers deal with the surface waters of the Missouri and Lower Mississippi Basin, the Great Basin, and California, and record the gauge readings and discharge measurements made in 1907–8. Covering as they do a large area where rainfall is slight, the results are interesting, though, of course, they extend over a short period only, and are intended to be a preliminary investigation. River velocities are determined by the Price current-meter, which is almost exclusively employed by the Survey, and in this way results of much value are obtained rapidly and from a very wide area. The other two papers treat of the quality of the surface waters of Illinois and California, especially with regard to their potability and their suitability for industrial purposes.

IN the last number of the Proceedings of the Royal Society (vol. lxxxiv., A, No. 572) is an important memoir by Sir George Darwin on the tidal observations made during Sir Ernest Shackleton's Antarctic expedition of 1907. The observations are shown by Sir George Darwin to demonstrate a tidal seiche in the Ross Sea, and from its period Darwin concludes that the sea extends far beneath the Great Ice Barrier into the Antarctic continent, passing to the east of the Pole and for at least 10° of latitude beyond it. He remarks that if this arm of the sea extends across Antarctica to the Weddell Sea the seiche would be much as the tidal observations indicate. It was remarked in a note in NATURE of May 12, on the expedition by Lieut. Filchner, whose plan is based on the assumption that Antarctica is divided into two parts by a sound connecting the Ross Sea with the Weddell Sea, that if the theory be correct some evidence in its favour should have been forthcoming from the tidal observations. Sir George Darwin's memoir shows that the tides offer striking evidence in favour of the direct connection between the Weddell and Ross Seas.

AMONG several useful papers in the Journal of the Scottish Meteorological Society for 1909 (recently published) there is one of especial interest by Dr. G. A. Carse and Mr. D. MacOwan giving a brief *résumé* of the more important facts connected with atmospheric electricity. Descriptions are given of some of the earlier methods of detecting the phenomena, and of Lord Kelvin's water-dropping apparatus, which is most widely used for measuring the atmospheric potential. Observations show that, in general, this factor varies with the time (there being in most places a diurnal and annual variation), and that, generally speaking, it increases in proportion to the distance from an extended horizontal surface if the distance between the points is not too great. It has, however, been found by balloon ascents that in fine weather it diminishes with height above ground, thus indicating that electrification is largely confined to the lower levels of the atmosphere. The annual variation has a maximum about mid-winter and a minimum in summer, but the periods of the diurnal variation are much more complex. Another factor of importance is the ionisation of the atmosphere, and this is now being investigated more thoroughly. A few of the more interesting of the various theories accounting for the phenomena of atmospheric electricity are briefly sketched, but, so far as known, none has yet been promulgated which sufficiently explains all the observed facts.

To the *Rendiconti R. Accad. Lincei* of October 2 Dr. Eredia communicates an interesting paper on the cold period of June in Italy. This cold period has already been shown to exist over a large part of Europe, and to be due to the mean distribution of pressure at that period. But as Italy possesses a valuable series of observations available for the purpose, the author has taken advantage of them to show that this cold period in Italy constitutes a real climatological factor. His tables show differences of the ten-day means of temperature from each other between the third decade of May and the first decade of July, for 120 stations, for the period 1866–1906. He also gives a map showing by various shadings the difference of temperature between the first and second decades of June for different regions. These clearly show that generally there is a considerable fall of temperature in the second decade of June, that it is much more marked in Upper than in Lower Italy, and is considerably influenced by geographical configuration.

AN interesting article by Dr. J. Mascart on actinometry and on meteorology at Teneriffe is published in the *Revue générale des Sciences* of November 15. The author points out that in the determination of the solar constant a difficulty arises at the outset; according to the definition, the receiving surface should be theoretically *black for all radiations*, having the properties of an integral radiator. Strictly speaking, this preliminary problem has not yet been solved. He described the so-called "absolute" instruments in use, which may be divided into two groups:—(1) calorimetric actinometers, which contain a liquid of known specific heat, of which that by Pouillet is the oldest; (2) those in which the electric energy necessary to produce the same effect as the solar radiation is measured; to this class belong the actinometers of Ångström and Féry. The Solar Committee has adopted as a type Ångström's compensation pyrheliometer. This decision is excellent as regards uniformity of observations, but might be harmful if it diminished the number of measurements with other apparatus. Reference is made to the observations made by the late Dr. W. Marcet and others on the extreme dryness at times of the Peak of Teneriffe, and on the electric phenomena there which seem to be connected with the former. The author considers the peak to be particularly favourable for observations on atmospheric phenomena and their connection with actinometry; also for observations of terrestrial magnetism. He thinks that more attention should be given to observations of zodiacal light, crepuscular rays, and atmospheric polarisation; these subjects are generally omitted from meteorological text-books because they are supposed to have no immediate connection with meteorology, but with this view he does not agree.

IN a communication made to the Illuminating Engineering Society on December 9th Prof. G. W. O. Howe showed that the darkening of the glass bulbs of Osram lamps sometimes noticed is due to the use of a slight amount of copper in the leading-in wires. This copper appears to be projected from the point at which the filament is joined to the negative leading-in wire, and forms on the inner surface of the bulb a distinct shadowgraph of

the glass stem and wire supports of the filament. It is obvious that the use of copper, even in small quantities, in the leading-in wires of these lamps must be avoided.

The device of doubling a wire on itself before winding it into a resistance coil reduces the inductance of the coil to a very small quantity, but unfortunately introduces a considerable capacity, which is equally undesirable if the coil is to be used in alternating-current measurements. Chaperon's method of winding the coil in sections, in each of which successive layers are wound in opposite directions and the magnetic area of each layer made the same, reduces the capacity considerably, but the more recent suggestion to balance residual inductance and capacity has been taken up by Dr. E. Orlich, of the Reichsanstalt, with marked success. He winds one layer of wire on a slate slab 5 by 12 centimetres and 3 or 4 millimetres thick with rounded edges, then places bridges over the edges and winds the second layer over the bridges. The distance between the two layers of wire is calculated so as to make the capacity and inductance equal for frequencies not very high. The results of the calculations are tabulated for resistance coils exceeding 3000 ohms, below which the method is not applicable.

We have received from Messrs. J. J. Griffin and Sons, Ltd., a new edition of "Scientific Handicraft." The volume, which contains more than one thousand pages, forms a very comprehensive catalogue of physical apparatus. Messrs. Griffin, in addition to supplying all that is most recent for advanced work in the physical laboratory, include in their list apparatus which is suitable for many technical industries. The catalogue is also issued separately in three parts, the first part dealing with laboratory fittings and apparatus for general physics, the second part with heat, light, and sound, and the third part with electricity and magnetism. The book is well illustrated, and is furnished at the end with tables of physical constants. It will no doubt find a place in all physical laboratories as a book of reference.

In a paper on the winning of coastal lands in Holland, read by Mr. A. E. Carey before the Institution of Civil Engineers on December 20, some interesting facts were given with reference to the gradual reclamation of the Dutch lowlands from the sea. The principal reclamations, which have so largely altered the map of Holland, were described, particularly that of the Lake of Haarlem, the first reclamation of which was carried out between the years 1540 and 1648. The so-called lake consisted of a vast swamp. The final works of reclamation were carried out by the State in 1840. Several of the breaches in the sand dunes on the North Sea coast appear to represent former embouchures of the River Rhine. The level of Amsterdam Peil, worked to by the Dutch engineers, differs only by about 1 foot from the level of the Ordnance datum. Some interesting facts ascertained in connection with the borings for the water supply of the City of Amsterdam were cited to show the delicate balance in water pressure which exists in the substrata of the Dutch fenlands. The gradual weakening of the natural protection afforded by the sand dunes was referred to, and some interesting evidence was brought forward to show how great the alterations in the position and magnitude of the dunes have been. Changes in location of the sand dunes are arrested by the planting of grasses on the faces of the dunes, and the protection of them on the land side by the planting of various kinds of trees. The controversy proceeding in Holland as to the best procedure in carrying out the project for the reclamation of the Zuyder-Zee, which involves the reclamation of 1,500,000 acres, was mentioned. Briefly, the alternative schemes are:—(1) to close the inland sea by a reclamation dam running from Wieringen to the coast of Friesland, near Piaam, thus shutting out the North Sea from the area to the south, the reclamation works being effected at leisure in the lake which would then be formed behind the dam; (2) to carry out the series of smaller reclamations before the closing of the entire sea.

The report of the Clifton College Scientific Society for the year 1909–10 has been received. We are glad to find that useful practical work continues to be done in the various sections into which the society is divided. An interesting series of notes on the birds of the Clifton neighbourhood, arranged chronologically, is published with the report.

OUR ASTRONOMICAL COLUMN.

The Spectrum of the America Nebula.—In a paper published in the *Sitzungsberichte der Heidelberger Akademie der Wissenschaften* (1910, No. 27) Dr. Max Wolf discusses spectrograms of the America nebula taken during October. The spectra were photographed with the Zeiss spectrograph, having two U.-V. prisms, attached to the Heidelberg reflector.

Referring the emission lines of the nebula spectrum to several Fraunhofer lines occurring in the stellar spectra shown on the same plate, Dr. Wolf finds for the former the following wave-lengths:—434, 412, 406, 389, 383, 373, and 343. Of these the chief lines occur at 410·2 (412), 383·7, 372·7, and 344·8 $\mu\mu$, the line at λ 373 being by far the brightest.

The Movements of Certain Stars, in Space, Compared with that of the Sun.—As an extract from the November *Bulletin Astronomique* we have received a paper in which Dr. P. Stroobant shows that the sun is probably a unit in a stream of stars moving through space in the same direction with a common velocity. As a primary index he takes those stars of which the movements, relative to the sun, are small, and then reduces their movements to a common plane.

The result is certainly striking, for Dr. Stroobant shows that the seven stars α Cassiopeiæ, β Persei, α Persei, α Scorpionis, γ Cygni, ϵ Pegasi, and α Pegasi are all travelling towards a polar area of only 14° radius, with velocities ranging between 11 and 22 km.; towards the centre of this area the sun is moving at a rate of 19·4 km. The probability that of the 105 stars brighter than magnitude 2·5 seven should, accidentally, shows this common motion, is very small, but it must be borne in mind that the data on which the result is based are, especially in the case of parallax, open to corrections.

Dr. Stroobant suggests that, with the accumulation of further, more trustworthy, data, other stars may be found to belong to the same stream, and he cites γ Pegasi, γ Persei, ζ Geminorum, α Hydræ, ϵ Leonis, η Leonis, ψ Ursæ Majoris, η Virginis, γ Aquilæ, α Pavonis, and η Pegasi as stars having small proper motions, and of which the radial velocities relative to the sun are also small.

The Italian Observatories.—In the *Rivista di Astronomia* (Turin) a series of articles is appearing describing in detail the various Italian observatories. In No. 10 Signor C. H. Loviselmi gives an excellent description of the observatory of the Roman College. The account gives the history of the observatory, describes the buildings and instruments, and gives short accounts of the various observers; it is illustrated with photographs of the buildings and portraits of Vico, Secchi, Ferrari, and Tacchini.

Astronomy at the Brussels Exhibition.—An interesting account of the astronomical exhibits at the Brussels Exhibition is given by Dr. Stroobant in the *Bulletin de la Société astronomique de France*, and now published as

a separate brochure. Photographs of the exhibits from Harvard, Mount Wilson, Heidelberg, and other observatories show that astronomy was fairly well represented at the exhibition.

TRACING THE SOLAR CORONA IN LUNAR OBSERVATIONS.—In the December number of the *Bulletin de la Société astronomique de France* M. Em. Touchet makes the interesting suggestion that observers may be able to trace the radiations of the solar corona in observations of the moon. The note was submitted to the Académie des Sciences in 1906, but did not appear in the *Comptes rendus*, and even now M. Deslandres considers the difficulties of realisation are about equal to those surrounding the photography of the corona in full sunlight.

The suggestion is that when the sun rises on the moon, the lunar surface, owing to the absence of atmosphere, would first be illuminated by fairly strong coronal light, then by the chromospheric radiations, and lastly by the photosphere. With the observer's spectroscope slit delicately adjusted on the position of lunar strip lighted by the corona, one might possibly find, in addition to the ordinary lunar spectrum, a narrow spectrum composed of that of the earth-light and the corona. M. Touchet realises that the difficulties are enormous, but suggests that, with a clear atmosphere, large dispersion, and the large apertures now available at Mount Wilson, for example, they might not prove insuperable.

ANNUAL PUBLICATIONS.—The "Companion to the Observatory," published by Messrs. Taylor and Francis at 1*s*. 6*d*., contains the usual features, and should be secured by every astronomical student actually engaged in making observations. The increase in the number of variable stars makes the publication of the complete list impossible. As the compilers of the "Annuaire du Bureau des Longitudes" have discontinued the computation of the variable-star ephemerides, the editors of the "Companion" can no longer rely upon that source of information.

M. Flammarion's "Annuaire Astronomique" also follows its usual form, and is a most useful work of reference to all interested in the popularisation of astronomy. Its review of the past year's astronomy and meteorology is also useful, while the special articles therein comprised are very interesting; among them we might mention notices on Halley's comet and the Paris floods of 1910.

AMERICAN HYDROGRAPHY.[1]

THE first impression which one gains in turning over the pages of these seven reports is that, if genius be, as Dr. Johnson asserted, an infinite capacity for taking pains, then the compilers of these statistical records possess that attribute in a very high degree. One turns over page after page of systematically prepared data, unquestionably the outcome of innumerable observations which have been carefully and religiously made through long periods of time, and one cannot but admire the patient, painstaking zeal of these scientific workers who have concentrated their energies on this special field of enterprise, in the service of their country, for the development of its resources and the expansion of its commerce.

The work is carried on under the auspices of the Geological Survey of the United States, and this relationship of hydrography to geology calls to mind the proud reply of the "Scarabee" to the Poet at the Breakfast Table:—"I am often spoken of as a Coleopterist," he said, "but I have no right to so comprehensive a name. The genus Scarabæus is what I have chiefly confined myself to, and ought to have studied exclusively. The beetles proper are quite enough for the labour of one man's life. Call me a Scarabeeist if you will: if I can prove myself worthy of that name, my highest ambition will be more than satisfied."

Hydro-electric Plant (developing 26,600 horse-power) on Puyallup River, near Electron, Washington.

This is the true scientific spirit: the concentration of thought and energy on one special branch of study to the exclusion of even cognate interests; the patient accumulation of facts and data, and their careful analysis and tabulation, within a purview sufficiently restricted for the capacity of the individual investigator—by these means alone is the practical knowledge of the world increased and its avenues of progress extended.

In order to appreciate the full utility of these records it is essential to recall the fact that the development of water-power in every civilised country is rapidly becoming an economic necessity. With the steady depletion of coal, lumber, oil, and natural supplies of fuel there arises a corresponding need for the exploitation of other sources

[1] Surface Water Supply of the United States, 1907–8. Bulletins prepared under the general direction of M. O. Leighton, viz., Paper No. 241, North Atlantic Coast; No. 243, Ohio River Basin; No. 244, St. Lawrence River Basin; No. 245, Upper Mississippi and Hudson Bay Basins; No. 248, Western Gulf of Mexico; No. 249, Colorado River Basin; No. 252, North Pacific Coast. (Washington: U.S. Geological Survey, 1910.)

of energy available for and adaptable to manufacturing purposes. Among these water-power stands pre-eminent, especially since the introduction of electricity, which has provided an easy and convenient means for the transmission of its energy. Then, in regard to flood prevention, domestic water supply, irrigation, and land reclamation there are obvious grounds for regarding the study of periodic flow in rivers and streams as a consideration of the highest importance. The damage arising from floods in the United States exceeds a hundred million dollars annually, and more than 70 million acres of the richest land are rendered practically worthless by reason of prevailing conditions of overflow and swamp. Amelioration of these natural defects can only be brought about by the collection of trustworthy data and a careful and thorough study of all the circumstances attending the phenomena in question.

Records of stream flow necessarily call for frequent and prolonged observation. They must embrace all stages and cover, if possible, the absolute maximum and the absolute minimum of discharge. This involves, in most cases, a period of at least five or ten years, and in some instances twenty years or more. It is regrettable that the compilers of these volumes have had to avow that a number of their records are of insufficient duration, owing to unforeseen reduction in grants and the consequent abandonment of certain gauging stations. The national exchequer is surely not so impoverished as to be under the necessity of exercising retrenchment in regard to so important a branch of the public service.

Three methods of stream-flow measurement have been adopted by the Hydrographical Department, according to the local physical conditions, the degree of accuracy desired, the funds available, and the length of time devoted to observation.

The first, most theoretical, and least used method is that of measuring the slope and cross-section of a stream, and then using the Kutter expansion of Chezy's formula. Owing to the difficulty of obtaining accurate data, and more particularly to the uncertainty attaching to the coefficients in the formula, results obtained by this method can only be regarded as approximately correct.

The second method is that of measuring the discharges over dams and weirs. Here the problem is complicated by variations in profile and crest, by leakages through the dams, backwater at high stages, log and ice obstructions, and local diversions of water for power purposes. On this account comparatively few stations are maintained at weirs and dams.

The system chiefly employed is that of measuring the velocity of the current, principally by the Price current meter, rarely by means of free floats, and, at the same time, determining by a series of ordinates from a datum line the cross-sectional area of the stream.

The following comments on the relative merits of the systems are interesting.

"Practically all discharge measurements made under fair conditions are well within 5 per cent. of the true discharge at the time of observation. Inasmuch as the errors of meter measurements are largely compensating, the mean rating curve, when well defined, is much more accurate than the individual measurements. Numerous tests and experiments have been made to test the accuracy of current-meter work. These show that it compares very favourably with the results from standard weirs, and, owing to simplicity of methods, usually gives results that are much more reliable than those from stations at dams, where uncertainty regarding the coefficient and complicated conditions of flow prevail."

Then there is, of course, the human element and the personal factor which enters into all experimental work. It is interesting to know that, "with relatively few exceptions, the observers perform their work honestly." Yet even honesty of purpose cannot eliminate every element of error, though the effect of numerous readings is obviously to minimise any inadvertent inexactitudes. Individualism counts for something, too, but, on the whole, errors arising from these and other causes become self-compensating and virtually negligible.

Merely to enumerate all the river basins comprised within the purview of the Hydrographical Survey would involve more space than can be spared for the purpose. From the noble Mississippi, with its drainage area of 1,240,000 square miles, including wholly, or in part, thirty States, besides a small portion of the Dominion of Canada, down to the modest Siletz, with its length of 50 miles and its basin of 320 square miles, there are measured and described all sorts and conditions of streams with names as musical as Menonimee and Wapsipinicon, as dissonant as Umpqua and Puyallup, prosaic as Muddy and fantastic as Devil's. The whole area of the country is to be covered by a dozen bulletins, of which the present seven form part.

B. C.

PALAEONTOLOGICAL PAPERS.

THE troublesome question of fucoids has exercised Mr. Otto M. Reis ("Zur Fucoidenfrage," *Jahrb. k.k. geol. Reichsanstalt*, Bd. lix., published 1910, p. 615), an author well known for his researches on ruin-marble and cone-in-cone. He accepts an organic origin for the fucoids collected by him in the northern Apennines and the Alps, and points out that the clay, which might be regarded as a mere infilling of a worm-tube, is in some cases so arranged as to form a true wall to the tube. The granulations on the surface of many fucoids may be regarded as due to clay-lumps used in the construction of the worm-tube. *Terebella figulus* is cited (p. 628) as an example of a worm that kneads up fine clay into bricks, as it were, which it places from its mouth on to the growing margin of its tube. The author expects criticism, since he sets aside the algal theory of the origin of fucoids in the Flysch, and ascribes the structures to boring and tubicolous worms.

Mr. E. W. Vredenburg (Records, Geol. Survey of India, vol. xxxvi., 1908, p. 241) has described certain "pseudo-fucoids" of eastern Baluchistan as casts of worm-burrows and tracks of marine organisms, here following the work of Nathorst.

Mr. M. D. Zalessky records (*Bull. Acad. imp. Sci. St. Pétersbourg*, No. 6, 1910) in a brief English paper the discovery of coal-balls in the Carboniferous of the Donetz basin, containing well-preserved plants, from the study of which much may be expected. Their mode of occurrence precisely resembles that of the English examples studied by Williamson.

Mr. Vredenburg (Rec. Geol. Surv. India, vol. xxxvi., p. 171) describes species of Orbitoides from the upper part of the Upper Cretaceous of India, including megaspheric and microspheric forms. As usual, this author interestingly connects his palæontological work with zonal considerations and with questions of Indian stratigraphy, which here occupy twenty-five pages of the paper.

The important manuscript work on dendroid graptolites, left by Dr. R. Gurley, has been revised and issued by Mr. R. S. Bassler (Bull. 65, U.S. National Museum, 1909). The forms described, including many species of Dictyonema, are from the Niagaran (Middle Gotlandian) Dolomites of Hamilton, Ontario. With one or two exceptions, like the Inocaulis on p. 48, the figures of these difficult fossils are limited to the forms of the rhabdosomes.

Proceeding to molluscs, Dr. A. Schmidt has examined the Anthracosiidæ of the Upper Carboniferous beds of Mährisch-Ostrau (*Jahrb. k.k. geol. Reichsanstalt*, Bd. lix., published in 1910, p. 733). The forms illustrated have naturally an interest for English geologists, and the paper both supports and supplements the work of Dr. Wheelton Hind. Dr. Schmidt points out the general tendency towards a uniform type of shell among the later members of this fresh-water group, while the animals very probably remained quite distinct. The reduction of hinge-teeth seems related to prolonged fresh-water conditions. The author doubts if the fresh-water shells of the Mesozoic era had fresh-water Palæozoic ancestors, since the Permian forms had already proceeded far towards uniformity of type, and probably altogether passed away. However, a mollusc described by Mr. L. J. Wills in a paper on the Keuper of Worcestershire, to be quoted later, seems possibly a survival of Naiadites. In the same volume of this *Jahrbuch* (p. 407, published in 1909) Dr. A. Till continues his work on the jaws of fossil cephalopods. In the absence of any guide to their correlation, these objects are

classed under the genus Hadrocheilus, and are distinguished by numerous specific names.

Mr. G. C. Crick describes a new genus and species of dibranchiate cephalopod, *Belemnocamax boweri*, from the Lower Chalk (Totternhoe Stone) of Lincolnshire (Proc. Geol. Assoc., vol. xxi., 1910, p. 360). Belemnocamax resembles Actinocamax generally, but has a broad ventral furrow, and fine longitudinal striæ near the point of the guard.

Dr. A. Till (*Verhandl. k.k. geol. Reichsanstalt*, 1909, p. 194) establishes a new genus, Villania, for an ammonite allied to Perisphinctes, found in an Oxfordian horizon at Villány, in Hungary.

Mr. T. D. A. Cockerell continues his studies of Tertiary insects (*Am. Journ. Sci.*, vol. xxvii., 1909, p. 381), introducing three new genera, and Mr. H. F. Wickham (*ibid.*, vol. xxix., 1910, p. 47) compliments him by describing *Calosoma cockerelli*, among other fossil Coleoptera from the Florissant (Oligocene) deposits of Colorado.

Mr. L. J. Wills (Proc. Geol. Assoc., vol. xxi., 1910, p. 302), in a paper on the fossiliferous Lower Keuper rocks of Worcestershire, describes in considerable detail three species of Mesophonus, a new scorpion, fragmental remains of which occur abundantly at Bromsgrove. Numerous photographs of these remains are given, as well as of the plants from the same strata.

Mr. Bashford Dean's studies on fossil fishes (sharks, chimæroids, and arthrodires) forms part v. of the ninth volume of the Memoirs of the American Museum of Natural History (1909). The memoir is finely illustrated, and deals mainly with the cladoselachians of the Devonian period, which are viewed, in agreement with the opinion of Dr. A. S. Woodward, as primitive sharks. The author regards them as nearer the earliest fish-type than are the acanthodians of the Upper Silurian epoch (p. 247). Photographs and descriptions of mounted skulls of Dinichthys and Titanichthys are also given.

The distribution of the Deinosauria in time and through geographical areas is the subject of a memoir by Mr. R. S. Lull (*Am. Journ. Sci.*, vol. xxix., 1910, p. 1). As the result of a wide range of reading, the author has drawn up distributional tables, and maps illustrating the probable routes of migration. The maps furnished by De Lapparent for various Mesozoic periods are found to supply the necessary bridges between existing lands in which deinosaurian remains have been found. Incidentally, several suggestive remarks are made. On p. 5 bipedal movement is associated with the necessity for rapidly traversing lands increasing in aridity. The bipedal lizards of the present day occur in semi-arid areas. The carnivorous and bipedal deinosaurs, the Theropoda, are the most widely distributed, and appear to have followed any other forms that furnished them with food. The armoured and herbivorous Orthopoda are regarded as originating with Scelidosaurus of the English Lias, and as having become sluggish and quadrupedal in the course of time, when their heavy armour rendered them impregnable (p. 11). At this period, including the epochs when Polacanthus and Triceratops flourished, vegetation and water seem to have been abundant. The mystery of the extinction of the deinosaurs is not lightened by the passing reference to geographical conditions on p. 37.

Mr. Harold Brodrick (Proc. Liverpool Geol. Soc., vol. x., part v., 1909, p. 327) describes and figures footprints, doubtless deinosaurian, found by him in the Inferior Oolite at Saltwick, south of Whitby. It would be very interesting to know if the zone also contains marine fossils, in view of Mr. Lull's comparison of aquatic deinosaurs and hippopotamuses, the latter having been seen to move from estuary to estuary through sea-water.

Mr. A. Zdarsky contributes a memoir on the Miocene Mammalia of Leoben, in Styria, to the *Jahrbuch der k.k. geologischen Reichsanstalt*, Bd. lix., 1909, p. 245. These occur in a terrestrial sandstone above clay and brown coal, the last-named stratum resting on Palæozoic slates. Various rhinoceroses and Suidæ occur. Among the latter, the author places a new genus and species, *Xenochoerus leobensis* (p. 264), represented by part of a mandible and a row of teeth from the upper jaw. Mastodon and Deinotherium are both present, and the deposit appears (p. 287) to be of Middle Miocene age.

Mr. Franz Toula, in the same journal (Bd. lix., 1910, p. 575), records the results of an investigation of a preglacial or interglacial bone-deposit near Kronstadt, in Transylvania. The mammalian remains collected from this in recent years have become somewhat scattered; but the author has examined most of them, and especially describes the teeth of a new form, *Rhinoceros kronstadtensis* (p. 580). Among the bones of Cervus there is a phalange that suggests the presence of the giant deer of Ireland.

The *Sitzungsberichte vom naturhistorischen Verein der preussischen Rheinlande und Westfalens* for 1908 (published in 1909) contains numerous abstracts of papers read before its component societies. Dr. Elbert described at Münster (Section C, p. 51) his expedition to Java in search of the predecessors of the human race. It may be well to recall that he found traces of hearths in deposits that showed the existence of man side by side with Stegodon. He believes that primæval man entered Java with the Siwalik fauna at the close of Cainozoic times, and that Pithecanthropus was entombed during a cold "diluvial" epoch, when floods were caused by the action of lavas on the snows. The evidence for this colder epoch is furnished by the fossil plants of the Kendeng beds, which represent species that now live at much higher elevations. Dr. Elbert considers that Pithecanthropus was forced to retreat before primæval man, while a land-connection was still open with Celebes, and that various pigmy races may have descended from this genus.

Without entering seriously on the literature of primitive man as a branch of palæontology, we may perhaps direct attention to the spirited description by the late Commandant Molard of the prehistoric drawings of animals in the cave of Niaux, in Ariège (*Spelunca*, tome vii., p. 3), and to Dr. Florentino Ameghino's illustrated account, previously promised, of stone implements found near Mar del Plata. The latter paper (*Anales del Museo Nacional de Buenos Aires*, tomo xx., April 22, p. 189) maintains that the pebbles with chipped ends are in some ways more primitive than eoliths, and attributes them to *Homo pampaeus* of the Tertiary era.

G. A. J. C.

A MONOGRAPH OF THE JELLYFISHES.[1]

ANY attempt to arrange the Medusæ of the world in a natural and convenient zoological system is beset with so many exceptional difficulties that the author of this very fine monograph must at least be congratulated on the courage he has shown and the patience he has exhibited in preparing and publishing his work.

Since Haeckel wrote his famous "System der Medusen" in 1879 there has been no other standard monograph on the group for systematic zoologists to consult, and the need for a comprehensive revision of his classification has been acutely felt. In many cases the forms which Haeckel described as distinct genera have proved, in the light of more modern research, to be but stages in the development of one genus; many new genera and species have been described, and our knowledge of the life-history, anatomy, and physiology of many of the old species has been very widely extended. To bring together the results of all these investigations into one great monograph, to criticise, and to rearrange the genera, is the task which Mr. Mayer has attempted, and, it may be said, with no small measure of success.

The principal difficulty in the systematic arrangement and nomenclature of the Medusæ arises from the fact that in some cases, but not in all, the free-swimming, bell-like and sexually mature organism represents only a stage in the life-history of an individual, or the detached sexual organ of an individual which has an altogether different form, and there are many examples of the sedentary or hydroid stage of a species being known by one generic name and the free-swimming or medusoid stage by another. It may have been an ideal of the earlier writers, which they themselves could not hope to attain, that ultimately the sum total of the life-history of a single species would be united under one generic and one specific name. But this ideal appears to be in these days not only

[1] "Medusæ of the World." By Alfred Goldsborough Mayer. 3 Vols. Vol. i., pp. iv+230+xv; Vol. ii., pp. iv+231-498+xv; Vol. iii., pp. iv+499-735. (Carnegie Institution of Washington, 1910.)

more remote, but even impossible to reach. As the author points out, such dissimilar hydroids as Syncoryne and Stauridium give rise to similar medusæ of the genus Sarsia, and on the other hand the dissimilar medusæ

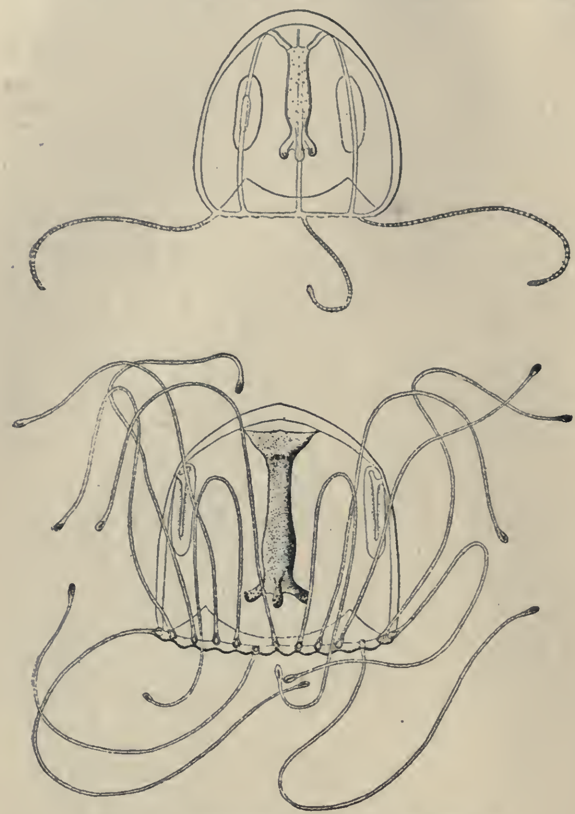


FIG. 1.—*Persa incolorata*, one of the Trachymedusæ.

Bougainvillia (formerly known as Hippocrene or Margelis) and Nemopsis are produced by gemmation from closely related species of the hydroid genus Bougainvillia. An attempt, therefore, to construct a system under which the name of the hydroid stage would supersede the name of the medusa stage, or *vice versâ*, even if it were confined to those species of which the life-history is known, would lead to a state of confusion even worse than that which at present exists. For the present, then, we may agree with the author that the nomenclature of the medusæ and the nomenclature of the hydroids must be, in the majority of cases, kept distinct, but at the same time regret may be expressed that he has not set forth his views of the classification of these Cœlenterates in some tabular form with the families of the hydroids and medusoids arranged in parallel columns. Such a table would necessarily be incomplete and subject to several exceptions in detail, but it would be extremely useful to those who are interested in the Hydromedusæ as a whole and of great assistance to naturalists who are endeavouring to work out their life-histories. Such a table has recently been drawn up by Stechow in a work on the Hydroids of Japan, which was published, unfortunately, too late to be reviewed in Mayer's memoir. A comparison of a table by Mayer, had he constructed one, from the medusoid point of view with that of Stechow from the hydroid point of view, would have given us a very instructive review of the classification of the Hydromedusæ as a whole.

But it seems somewhat ungracious to begin a notice of work that is characterised by so many excellent features by complaining about an omission.

The first point that will strike the ordinary zoologist, who is not a specialist in any one group, as a very welcome and important novelty in monographs on systematic zoology, is the inclusion in the text of a statement concerning all the important contributions to our knowledge of embryology, cytology, and physiology of the subject group. This is not a work that can be set aside as a systematic treatise, of value only when it is required for the identification of a species, but it is one that can and should be consulted by all those who are interested in the morphology of the group. Special attention may be directed to the excellent accounts, given in various places in the text, of the physiology of the rhythmic contractions of the bell, and the lucid statement concerning the recent researches by Stschelkanowzeff on the extraordinary developmental process in Cunina described by Metschnikoff as "sporogony"; but there are many others to relieve the tedium that is inseparable from a series of purely systematic descriptions.

In dealing with the two genera Ctenaria of Haeckel and Hydroctena of Dawydoff, which have been supposed to connect the true Cœlenterates with the Ctenophora, the author takes the perfectly sound position that the resemblances relied upon indicate no true genetic relationships between the two classes, but he incidentally directs attention to an interesting observation of Woltereck's that in the larva of Solmundella and in the actinula larva of Tubularia there is an apical pole-plate of ciliated ectodermal cells. This does not constitute an aboral sense-organ on such an elaborate scale as that described in Hydroctena, but it indicates, at least, that this organ is

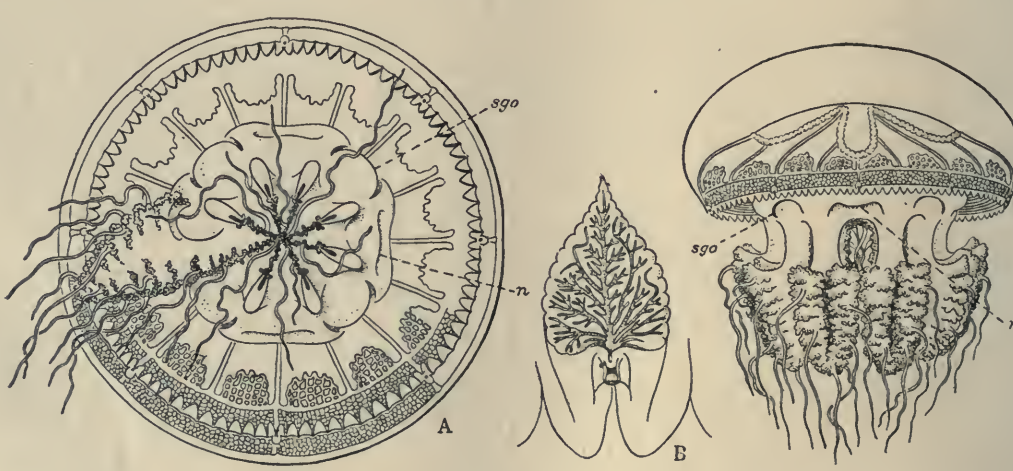


FIG. 2.—*Lychnorhiza bartschi*, one of the Rhizostome Scyphomedusæ. A, Oral view. B, Sense-organ seen from exumbrella side.

not necessarily a sign of Ctenophore affinities. As in other divisions of the Cœlenterata, the determination of true or natural specific distinctions in Medusæ from false or accidental differences is extremely difficult. A great many species have been described from the more or less distorted and contracted specimens that are sent to systematic zoologists by the collectors, and it is very probable that many of the folds and wrinkles, and even the warts and tubercles, that are relied upon for separating species are due to post-mortem changes. Mr. Mayer deals with this problem with sound judgment. The work of previous authors is carefully considered and tabulated, so that the reader may form his own judgment in each case if he wishes to do so; but his own opinion, based on a wide experience of living and preserved material, is clearly expressed. Thus, of the genus Pelagia, no fewer than fourteen species have been described, of which six are from the Atlantic Ocean. "All of the Atlantic species," he says, "are closely related one to another, and future researches may demonstrate that they are only geographical races."

It would be difficult to express adequately our admiration of the seventy-six coloured plates with which this monograph is illustrated. As regards delicacy of treatment and accuracy in detail, they may be regarded as the best series of zoological plates that have been published for many years. In addition to the plates, there are more than four hundred text illustrations in black and white. The majority of these are copied from the works of other authors, but there are several, such as the two specimens we reproduce, that have not been previously published.

Important changes in well-known generic names are not so common as in some other recent memoirs, but there are some which many students of the group will notice with regret. Thus the familiar genus Lizzia becomes merged in Rathkea; Corynitis becomes Linvillea. The generic name Turris, having been used by Humphrey in 1797 for a mollusc, is regarded as preoccupied, and this genus of Medusæ becomes Clavula. As examples of changes in spelling, we may refer to the genus Irene, which becomes Eirene, and Aurelia, which becomes Aurellia. But the most deplorable proposal in this respect is that the name Craspedacusta should be used in place of Limnocodium. It is clear from the text that the author has made this change with regret, since he realises the great inconvenience that must be caused by the substitution of a name that has been used only once, and in a preliminary note, for a name that has been used consistently by all authors, including the writer of the preliminary note, ever since. That the change has been made is due to the mandate of the International Commission on Zoological Nomenclature, who stated that the usage of the name Limnocodium would be "in contravention of the provisions of the Code." No better example could be found to show the pressing need of some revision of the Code. We cannot close this notice without again expressing our thanks to Mr. Mayer for his most magnificent and serviceable memoir. It is really a great work, and will mark a great step of progress in the literature of the subject.

MEASURES OF SOLAR PARALLAX.[1]

THE particular value of solar parallax derived from the discussion of any one set of measures is of smaller consequence than the manner in which the result has been achieved. The interest in the problem has shifted. In its present position, the knowledge of the distance of the sun from the earth is less important than the examination and elimination of the causes that affect the accuracy of the measured coordinates obtained from a series of plates. Viewed in this light, Prof. Perrine's paper is of great value, for it puts us in possession of an independent discussion of material that has already been submitted to the most careful scrutiny.

We have presented to our examination a numerical estimate of the different constructions that expert knowledge can place upon the same measures. Mr. Hinks, in his elaborate discussion of the solar parallax from photographic observations of Eros, pointed out some discrepancies in the Lick results, which he thought required further examination. Among others, he suggested that some of the comparison stars were too distant from the axis of collimation. Apparently this criticism was justified, and Prof. Perrine has employed in his reductions only those star images which were accurately circular. A second suggestion, that an error was introduced by the eccentric position of Eros with reference to the stars of comparison, is not accepted. This want of symmetry arose from the plan of choosing the same stars for the morning and evening observations, a scheme which possesses obvious advantages; but in a plate taken with Eros always in the centre, the motion of the planet will carry it nearer to, or away from, the more outlying members of the group of stars selected for measurement. The motion of Eros in the interval was about 8′–10′, and in a field the available diameter of which is small the distortion of the image might outweigh the evident theoretical advantages.

To test this point Prof. Perrine has made two solutions, according to the stars selected, and can find no evidence of systematic error. Another attempt to explain the observed discrepancy, more of the nature of a suggestion than a criticism, was made to depend upon the generally small magnitude of the comparison stars. With a large aperture and the necessity of restricting the field, there will be a tendency to use fainter stars than in other observatories employing the ordinary photo-refracting telescope. As a rule, the stars selected at Lick have been fainter than the planet. Prof. Perrine does not specifically discuss the effect of magnitude, and there is the less necessity, since the value of the solar parallax he obtains does not show any anomalous deviation from the final value adopted by Mr. Hinks.

The difference of computational results is a point of great interest. The final value of solar parallax derived from the total mass of measures at the command of Mr. Hinks is 8·807″, while the same authority obtained from the Lick measures alone 8·815″. From the same data Prof. Perrine derives from his own measures 8·8067″, or identically Mr. Hinks's result. The problem for solution has therefore moved from finding an explanation of the difference of Lick results from the general average to tracing the cause of the disagreement between the Cambridge and the Californian computations. The computed probable errors also differ. That attached by Prof. Perrine in his final equation for π is $\pm 0{\cdot}0025''$, and by Mr. Hinks $\pm 0{\cdot}0046''$. It is a matter for congratulation that such small differences should attract attention and call for explanation. The minuteness of the discrepancy seems to indicate that in modern processes such a degree of refinement has been reached that the disagreement must be attributed to purely arithmetical operations, and has no physical significance.

[1] "Determination of the Solar Parallax," from Photographs of Eros, made with the Crossley Reflector of the Lick Observatory, University of California. By Charles D. Perrine, and others. Pp. v+98. (Carnegie Institution of Washington, 1910.)

AMERICAN VERTEBRATE PALÆONTOLOGY.

THE phylogeny of the Felidæ forms the subject of an article, by Dr. W. D. Matthew, published in vol. xxviii. (pp. 289–316) of the Bulletin of the American Museum of Natural History. According to the author, the great majority of the extinct members of the family, including all the oldest species, are characterised by a more or less pronounced development of the upper canines into long, flat-sided tusks. These are the so-called sabre-tooths, or machærodonts, which date from the Lower Oligocene, typical cats with relatively short upper canines being unknown before the Pliocene. The early sabre-tooths are, however, divisible into two series, one characterised by the extreme length and slenderness of the tusks and the large size of the protecting flange on the lower jaw, and the other by the shorter tusks and smaller flange. Hoplophoneus and Dinictis respectively represent the two series in America. While the derivation of the large Pliocene and Pleistocene sabre-tooths from Hoplophoneus has been accepted, the relations of the modern cats to Dinictis have been overlooked. "The evidence appears, however, to indicate that the Dinictis phylum led

directly into the modern Felidæ, the canines having reverted from the almost unique machærodont specialisation to the normal type of carnivorous mammals. The series Dinictis—Nimravus—Pseudælurus—Felis are in direct succession, structurally and geologically."

In the opinion of Dr. Matthew the origin of the cat family cannot be carried back further than the Oligocene sabre-tooth, their supposed derivation through the so-called Ælurotherium—which is based on the milk-dentition of a species of the same group—from the Eocene creodont Palæonictis being inadmissible.

Mr. R. O. Peterson has, however, just described, under the name of Daphænodon, in the Memoirs of the Carnegie Museum at Pittsburg (vol. iv., No. 5), the skeleton of a dog-like carnivore of the size of a large leopard from the Miocene of Nebraska, which, together with the allied but older Daphænus, he regards as in a considerable degree intermediate between dogs and cats, although the skull and teeth are essentially dog-like. In many respects Daphænus, of which the whole skeleton is known, is very cat-like, especially in the long leopard-like tail, which may, however, have been bushy. A cat-like feature is the partially retractile structure of the claws. In concluding his description, Mr. Peterson observes that the model "is instructive, as it furnishes at least a conception of a primitive form ancestral to cats and dogs." Whether later discoveries in earlier strata will reveal a community of origin for the two groups remains to be seen.

Reverting to the first article, Dr. Matthew replies near the end to critics who have doubted his theory that the sabre-tooths attacked by dropping the lower jaw into a nearly vertical position and stabbing with the upper tusks. After supporting the theory by additional anatomical evidence, he remarks that most of the early large ungulates were of the "pachyderm" type, which were specially suitable to this method of attack, while they would succumb to the mode practised by lions and tigers.

"With the rise and dominance of the large light-limbed ruminants and horses some of the early sabre-tooths were correlatively adapted into the modern type of felines, while other sabre-tooths, as the surviving pachyderm phyla became larger, thicker skinned, and more powerful, became progressively larger, more powerful, and developed heavier weapons to cope with and destroy them. The final extinction of the machærodont phylum was probably largely conditioned by the growing scarcity and limited geographic range of the great pachyderms."

Finally, he protests against the idea that these later sabre-tooths died out as the result of over-specialisation.

Recent conflicting opinions as to the pose of the sauropod dinosaurs are discussed by Dr. Matthew in the September number of the *American Naturalist* (vol. xliv., p. 547). That these reptiles walked, instead of crawling, the author considers fully proved, their limb-structure, as was previously pointed out by Dr. Abel, displaying a remarkable parallelism to that of proboscideans. This "rectigrade" type, in which the whole limb is pillar-like, with the foot short, rounded, and heavily padded, and the toes reduced or rudimentary, is correlated with gigantic bodily size, the movements being mainly restricted to the upper joints, and the foot serving chiefly as a cushion to minimise the shock. A structure of this kind will obviously occur only among animals which habitually rest their weight on the limbs alone.

A limit is, however, soon reached in regard to the weight which even the most powerful limbs are capable of supporting in the case of a purely terrestrial animal, and this limit appears to have been attained among the elephants. But if this be so, we are confronted by the question why the sauropod dinosaurs, with their less perfectly formed limbs, vastly exceed the largest elephants in bulk and stature. The answer, in Dr. Matthew's opinion, is that these reptiles were aquatic, and adapted to wading. "A wading animal has the greater part of its weight buoyed up by the water, and might attain a much larger size without transcending its mechanical limitations, just as the whales and some true fishes attain a much larger size than any land animal."

In 1908 Mr. Lambe described a new genus of crocodile (Leidyosuchus) on the evidence of imperfect remains from the Judith River beds of Alberta, Canada. An unusually well-preserved crocodilian skull from the Ceratops beds of Wyoming, recently acquired by the U.S. National Museum, is referred by Mr. C. W. Gilmore (Proc. U.S. Nat. Mus., vol. xxxviii.), in spite of its later geological horizon, to a second species of the same genus, under the name of *L. sternbergii*. A second skull of the same species, from the Hell Creek beds of Montana, which came under the author's notice after the original paper was written, is also described and figured.

Leidyosuchus may now be characterised as a short and relatively broad-skulled crocodile, with the nasals apparently not reaching the nares, the posterior nostrils wholly enclosed by the pterygoids (instead of being behind them, as in Crocodilus), the mandibular symphyses short and formed in part by the splenial, the upper teeth more numerous than the lower, the first lower tooth received into a pit, and the third and fourth—which are about equal in size—into notches in the skull. The vertebræ have the cup in front; and there was armour on the lower as well as on the upper surface of the body. Many of these characters connect the genus with Crocodilus on one hand and Alligator (including Caiman) on the other, although their preponderance is with the first-named genus. There are also indications of affinity with the Tertiary Diplocynodon. The position of the posterior nostrils—intermediate between those of modern and Jurassic crocodiles—is just what might have been expected from the geological horizon of the genus.

Since its original description by Sir R. Owen in 1873 the imperfect skull of the saw-billed bird (*Odontopteryx toliapica*) from the London Clay of Sheppey, preserved in the British Museum, has remained the sole evidence of its genus and species. When complete the specimen probably measured something like 6 inches in length. The discovery is now announced by Mr. B. Spalski, in the second number of the new journal published at Leipzig under the title of *Der Geolog*, of the skull of a much larger species of the same genus in Tertiary strata in Brazil, the total skull-length being no fewer than 53 centimetres. The name *O. longirostris* is proposed for the Brazilian species.

THE INFLUENCE OF RIVER SYSTEMS IN THE EAST.

GLOBUS for September 1, Bd. xcviii., contains an article of some interest on the subject of the influence of river systems in the East, by Herr Ewald Banse. The author deals with the area between 17° and 36° N. lat. and 17° W. and 74° E. long. (which he terms the Orient), where the average annual rainfall is less than 200 mm. (8 inches); this is bordered in the southern Sahara and in the northern part of south-western Asia by a broad zone with an annual precipitation of 600 mm. (23½ inches). In summer this area is the hottest part of the earth's surface. It tends to prevent the intermingling of various flora, fauna, and human races; the Arabian peoples, the one-humped camel, and the date-palm are mainly confined to it. The map accompanying the article shows three main areas, which are drained by no rivers—the Saharan, the Arabo-Syrian, and the Irano-Armenian, the undrained regions amounting to 77 per cent. of the Orient.

The central regions, with their entire lack of hydrographic connection with the ocean, differ essentially from peripheral countries with sea-connection. The formation of level plains is one marked tendency of countries devoid of rivers; wind, which forms the sole connection with the ocean, plays a very important *rôle* there. These flats are to be regarded as phenomena of disease in the earth's surface, and the fact that three-quarters of the Orient is devoid of river systems will account for its low population and helps to explain its cultural backwardness. It is the watered areas—23 per cent. of the whole—which have produced the cultures of the Orient, *e.g.* the Sumerian within the Anatolian-Kurdic belt. Higher cultures concentrate where there is flowing water all the year.

Four regions are passed in review, the Atlas countries, the Sahara region, south-west Asia, and western Asia. For each a table is drawn up giving the total area, proportions of permanently river-drained, periodically river-drained, and entirely undrained land, and the density of the population—the last, it may be noted, is in inverse

ratio to the extent of riverless country. These statistical data are summed up in a fifth table. The Sahara region is most intensively characterised by lack of river-systems; no rivers rise there, and those which flow through lose rather than gain during the transit. Eighty-eight per cent. of this region is without off-flow. This huge desert area Herr Banse regards as "the surest bulwark of Islam in Africa."

RECENT PROGRESS IN ELECTRIC LIGHTING.[1]

Incandescent Lamps.

THE most remarkable development within recent times is the production of an incandescent lamp with an efficiency approximating to 1 candle-power per watt. The best known of these lamps are of two kinds, one made with tantalum as the material for the filament, and the other with tungsten. There are a great number of lamps under a great variety of different names using tungsten, and the difference between the lamps is largely due to the differences in the processes of manufacture adopted. The most recent development in the construction of tungsten lamps is in the use of wire-drawn filaments (L. Gaster, Cantor Lecture, 1909).

In order to test a statement that has been frequently made as to the bad effect of switching off and on, a series of tests is being carried out in the Electrical Engineering Laboratories at Liverpool in which the lamps are switched off for ten seconds and then switched on again, the process being repeated at intervals of one minute. Although these tests are not complete, the results, so far as they go, have been interesting. In all, twenty lamps, which have been supplied by several makers, are being subjected to this test. The lamps were divided into two groups, and each one was adjusted to have an initial efficiency approximating to 1·4 watts per candle-power; this adjustment was effected by introducing resistance into the circuit of each individual lamp. One set of ten lamps was connected in circuit with an automatic switch driven by a small fan motor at such a speed that a cam switched on the light for fifty seconds and switched it off for ten seconds. The reason for this choice of time was that it appeared that ten seconds was enough to allow the filament to become practically cold, and thus to give the maximum contraction and expansion of the thread. So far as the experiments have gone, the effect of switching does not appear to be serious; the lamps that have been burning continuously have given out to the same extent as those that have been subjected to the continuous switching off and on.

The effective life of these lamps is found by them to be roughly proportional to the 3·65th power of the initial watts per candle-power, a law which corresponds with that found for carbon filament lamps.

We may sum up the position, so far as metallic filament lamps are concerned, by saying that at present there is no difficulty in obtaining a 230-volt metal filament lamp of about 25 candle-power which will give one horizontal candle-power for 1·2 watts, and will burn near this efficiency for more than 1000 hours, probably for a much longer period under ordinary conditions.

Before leaving the subject of incandescent lamps, it may be of interest to make some remarks on the character of the light that is emitted from them. The spectrum obtained corresponds with the spectrum given by an incandescent body, *i.e.* it is a simple band spectrum. So far as my own observations have gone, there is no evidence of selective emission, and the increase in efficiency of metal filament lamps may be said to be entirely due to the higher temperature at which the lamp filament runs. The wave-length of maximum emission intensity corresponds fairly closely with Wien's law for the radiation emitted by a black body. (It may be of interest to note here how nearly the temperature of maximum emission intensity for the yellow line, D, or centre of the visible spectrum about 6200° C., corresponds with the estimated temperature of the sun.)

The nearer we can approach the temperature of the sun with artificial sources of light, the more nearly will an illumination be obtained which corresponds in all regards with sunlight.

Arc Lamps.

The most notable advance in arc lighting within recent years is the flame arc, but these lamps have been used so extensively for a number of years that the flame arc itself is far from being a recent development.

It is my intention in this paper to lay stress on only two points:—(1) the improvements made in the distribution of light so as to give more uniform illumination over a large area; (2) the actual efficiency or flux of light emitted per watt consumed in a modern lamp.

The attempt to obtain more uniform illumination on the surface has been made in two ways, first by using vertical carbons instead of **V** carbons, as in the earlier form of flame lamps. As has been pointed out by many people, the candle-power curve required to give uniform horizontal illumination is much more closely approached by the polar curve of light distribution given by a vertical carbon lamp than by any other form.

The second method which has been adopted with the view of improving the light radiation from **V** carbon lamps is by the use of special globes. The most notable example of this is the use of the dioptric globe.

(2) Actual efficiency of modern arc lamps as measured by the influx of light per watt consumed (see subjoined Table).

Type of lamp	Volts	Current	M.H.S.C.P.	C.-P. per watt
Enclosed flame lamp				
(clear globe)	58	8·45	2200	4·5
(opal globe)	57·8	8·5	1430	3·0
Open flame arc (slightly obscured globe) ...	40	7·0	1040	3·72
Singly enclosed arc ordinary carbon ...	86	8·5	1150	1·6
Midget singly enclosed arc lamp	77	3·2	245	1·0

Vapour Lamps.

The production of light from an incandescent vapour is a method of lighting which has long been familiar, though the only practical examples of it are the mercury vapour lamp and the Moore tube. The two forms of mercury vapour lamp which are being manufactured at present are the quartzlite lamp and the silica lamp.

The main characteristic of this lamp is that it produces a large amount of ultra-violet light, to which quartz is transparent, and which is screened off from the exterior by a heavy lead glass clover. If the lamp is left burning without this cover for a few minutes the smell of ozone produced is very strong. It is a matter for discussion whether mercury vapour lamps containing these very strong lines only in the spectrum will not ultimately prove injurious to the sight of those who are obliged to work in it. *A priori*, it would seem to be bound to produce a fatigue of those parts of the retina which respond to the impulses given by the particular rays which the lamp emits.

A lamp of this type has recently undergone test in my laboratory, with the result that the efficiency worked out at 1·73 candle-power (mean hemispherical) per watt. The lamp consumed 688 watts at 230 volts, and gave a mean hemispherical candle-power of 1190.

The mixing of the mercury vapour light with that of the light from tungsten lamps has been tried at Liverpool with quite satisfactory results, the ratio between the amount of light required to produce complete mixing being very easily found by the aid of the globe photometer and two pieces of milk glass, one piece illuminated by a beam of daylight from the outside and the other by the light diffused on the surface of the globe by the two sources of light inside the globe. This method is, of course, not so exact as the colorimeter of Ives, but gives quite satisfactory results.

[1] From a paper read before the Illuminating Engineering Society on December 9 by Prof. E. W. Marchant.

SMOKE AND ITS PREVENTION.[1]

UNDOUBTEDLY the most important question of the day from the sanitary and artistic point of view is how best to combat the smoke nuisance, which, like a cumulative poison, is slowly but surely saturating our lives and homes with its filthy dregs, and is at the same time like a cancer depleting and destroying our natural strength by the waste of our already rapidly diminishing fuel supplies.

When, in the thirteenth century, bituminous coal was first used for fuel purposes, the smoke to which it gave rise roused such indignation amongst the public that a decree was passed in 1306 forbidding its use; but fuel had to be found, and the supply of timber proving insufficient, once more attempts were made to introduce it, but again public opinion led to its banishment in the reign of Queen Elizabeth. The third attempt, however, to bring it into use proved successful, and slowly the consumption increased, until the last century saw coal firmly established, not only as a fuel for domestic consumption, but also as our great source of power, and it was the possession of great stores of the fuel that gave England her commercial supremacy.

The smoke from the few chimneys where coal was used by our forefathers, and which so shocked the sense of the observers of that day as to lead to its use being banned, was an absolutely negligible quantity as compared with the smoke belched forth into the air in any of the large cities of to-day, and the effect upon our climate, our health, and our buildings has so steadily risen with the increase in consumption that it is no exaggeration to speak of it as a cumulative poison.

It was only in the latter half of the last century that the cumulative effect of smoke began to make itself appreciable, and the 'eighties and 'nineties were marked by a diminution in the hours of sunshine in our big cities and by fogs of remarkable density and lasting power; but such legislation as was enacted and the efforts of those interested in smoke abatement have apparently had some slight influence in a reduction of the plague, and certainly during the past ten years the fogs have not been of the same density or so frequent as in the preceding twenty or thirty years, but how far this has been due to efforts at smoke abatement and how far to meteorological conditions I, at any rate, am unable to say. It is an absolute fact that even if a certain amount of work has been done, so much still remains to do that the subject is as important now as it was ten years ago, and my desire this evening is to attack the subject of smoke from the more chemical and physical side of its production, and to review those methods which are practically possible for its prevention.

It must be borne in mind that the smoke question not only affects the well-being of the country, but also implies a waste of fuel so great that with the problem of failing coal supplies looming on the horizon it behoves us to make a national matter of it, not only from a hygienic, but also from an economic point of view. Indeed, the whole question of fuel economy is so closely allied to the problem of smoke prevention that it is impossible to consider the one without the other, and if only rational methods of heat production were adopted, both economy of fuel and cleansing of the atmosphere would follow.

The principal source of the cloud which hangs over our big towns, cutting off the direct rays of the sun and ruining health, varies with the locality. In the south of England it is the domestic grate using bituminous fuel which is responsible for the major portion of this pollution of the atmosphere, whilst further north, in the great manufacturing centres, it is the factory shafts which emit the pall of black smoke that aids in shortening life and killing vegetation, and which begrimes and finally helps to destroy our public buildings.

Many estimates of the relative amount of pollution due to manufactories and to the domestic grate have been made, but as the question of what is the ratio of smoke production from the various sources varies enormously with the locality, no very satisfactory conclusion has been arrived at.

[1] A lecture delivered at the London Institution on December 8 by Prof. Vivian B. Lewes.

With regard to London, Dr. Shaw's estimate that 70 per cent. of the smoke is due to the domestic fire would probably be about correct, but in Sheffield or Birmingham the figures would most likely be reversed. But it is a certain fact that domestic smoke is produced throughout the whole length and breadth of the land, whereas the factory chimney concentrates its attention on the more limited area of the manufacturing districts.

Although it is difficult to gain any idea of the ratio of blame to be given to the two greatest sources of smoke production at any one spot, yet it is easy to obtain an insight as to the relative total amount of smoke so produced from the uses to which our coal is put, and the Royal Commission on Coal Supplies arrived at the conclusion that, of the 167 million tons of coal burnt in this country in 1903, 36 millions were used for domestic heating, whilst, after deducting the coal used for gas making, it would probably be near the truth to say that the domestic use of bituminous coal is responsible for one quarter of the smoke pollution of the country, the responsibility for the remainder being split up amongst the various manufactures and railways.

Practically all the advances of late years have been in fuel consumption on the large scale, and the improvements brought about by stoking machinery and attention to air supply have been great, whilst some of the largest manufactures have demonstrated, not only the ease of obtaining smokeless factory shafts, but also the economy that accompanies them.

Little, however, has been done to improve the conditions of fuel consumption in the household, and in spite of the fact that the use of bituminous fuel in the domestic grate has been condemned for the part it has played in the pollution of the atmosphere from the earliest years of the fourteenth century to the present day, the ideas that exist as to its composition and method of production are still very vague, and it is this side of the question with which I now desire to deal. In an ordinary open fire radiant heat given by the incandescent fuel and heated grate warms the room, and although it is undoubtedly a wasteful method, owing to the largest proportion of the heat escaping up the chimney with the products of complete and incomplete combustion, yet it is so superior from the hygienic point of view, and so much more comfortable than any other method of heating, that it still holds the premier position in spite of the economic advantages of central heating systems or slow combustion stoves.

The production of smoke from the ordinary open grate using bituminous coal means a waste of fuel, but although this loss assumes grave proportions when the number of fires is taken into consideration, it is small as compared with the other losses due to actions taking place in the fire itself and the loss of heat escaping up the chimney. When bituminous coal is fed on to the burning fire, the action which takes place on the newly added portion closely follow the lines of action occurring during the distillation of coal, and it is during this period that a very large proportion of the heat units in the coal are lost, owing to the amount taken up in decomposing the coal and converting the volatile portions into vapours and gases. During this period the coal, heated by the fire from below and comparatively cool above, distils off tar vapours, coal gas, and steam in proportions which vary with the temperature. In the early stages, the surface of the fuel being too cool to lead to their ignition, they escape as vapours up the chimney, mingled with an amount of air which is dependent upon the draught of the chimney, and ranges from eight to thirty thousand cubic feet per hour. In an ordinary flue the composition of the escaping products may be taken as approaching to the following analysis:—

	Per cent.
Carbon dioxide	0·70
Methane	0·36
Hydrogen	0·29
Carbon monoxide	0·01
Oxygen	19·85
Nitrogen	79·79

and these gases, together with water vapour, escape up the chimney.

During this period of smoke production no soot is formed, and the physical properties of the cloud of vapour are an interesting study, as it explains one of the secrets of the lasting power of smoke and the way in which it acts. A most beautiful and instructive experiment is one devised by Mr. F. Hovenden, which shows to perfection the structure of smoke as it escapes from a burning object. A puff of smoke blown through a small glass cell illuminated from below by an oxyhydrogen or arc light, and examined under a low-power microscope, reveals the fact that it consists of excessively minute vesicles which are in a marvellous condition of motion, and which, owing to the gas within them being lighter than air, remain floating in the stream of air or gas until impact with a solid surface causes a bursting of the little liquid envelope, forming a microscopic drop of tar on the solid against which it has struck, and liberating the contained gases.

The wonderful movement of these vesicles is the most beautiful realisation that I know of our conception of molecular motion, and the marvellous way in which they keep up a continuous bombardment would be a perfect lecture illustration of kinetic energy if only it could be projected on the screen.

Given proper conditions, most condensing vapours seem to assume this form, and the small vesicular masses seem to retain the molecular activity of the particles that build them up, and there is little doubt that in fog or cloud it is this formation that gives the floating power, as the water vapour contained by the vesicle is only a little more than half the weight of air, and also explains the formation of rain by gun-fire and the dispersion of fog by electrical discharges, the bursting of the vesicle in each case leading to precipitation.

The tar vapour which escapes during the distillation of coal, either in the gas-maker's retorts or upon an open fire, consists of a mass of vesicles of this character, and this period is the one in which the most serious waste takes place, as not only is the greatest amount of heat being rendered latent by the distillation from the coal of these products, but they also escape unburnt up the chimney. After a while sufficient heat finds its way through the coal to the top of the fuel to ignite some of the escaping vapours, and the bright luminous flame then makes its appearance above the fire. This flame radiates a considerable amount of heat owing to the incandescent particles within it, and the waste of heat diminishes; but it will be seen that a large amount of vapour is still escaping unburnt, owing to the dilution of the hydrocarbon gases by steam and the cold air sucked in over the surface of the fire, which lowers their temperature below the point of ignition.

The appearance of the flame itself is worthy of notice, as the chemical changes taking place within it make it red and lurid towards the top, and the particles of oily carbon which form the soot escape from it.

Flame is caused by the combustion of gaseous matter, and when the air supporting the combustion is supplied externally to the combustible gas, the resulting flame is always hollow, consisting of at least two parts, an outer zone in which combustion is taking place, and an inner zone in which, there being no oxygen to carry on the combustion, no such action can take place. The ordinary luminous flame, such as is employed for illuminating purposes, is divided into four parts, but for present purposes our fire flame may be looked upon as consisting of only three, the inner zone being an area in which no combustion is taking place, but in which the gases are subjected to the baking action of the heated envelope that surrounds it, and undergo many decompositions, the most important chemical change being the conversion of any hydrocarbons into acetylene. In the outer zone combustion takes place in contact with air, giving the hottest part of the flame, and as the result carbon dioxide, carbon monoxide, and water vapour are formed; whilst between the inner and outer zones is a brilliantly luminous sheath giving the major portion of the cheerful firelight, whilst higher up in the flame, if combustion is not complete, this luminous portion becomes dull red and gives out far less light, and above this again smoke begins to appear in considerable quantities. These gradations in appearance are due to the acetylene and kindred bodies formed by the baking action of the outer zone on the hydrocarbons in the gases and vapours passing through the dark inner zone, entering the heated zone of combustion, when the acetylene suddenly splits up under the influence of heat into carbon and hydrogen, the latter of which burns and adds to the general heat of the flame, whilst the carbon raised to incandescence partly by the heat generated during its own formation from the endothermic acetylene and partly by heat from the flame, as well as by its own combustion, gives out the light. If the combustion were completed no smoke would be formed, but the diluting influence of the nitrogen and other products from the fire beneath and the cooling influence of the chimney draught so check and hamper the completion of the combustion of the products from the decomposed acetylene that the top of the flame is cooled to a dull red, and the flame is finally extinguished before all the carbon particles can be consumed, this producing the sooty smoke which passes up the chimney. The smoke does not consist merely of the liberated carbon particles, but contains tar vapour, water vapour, products of combustion, and excess of air, together with the residual nitrogen from that portion of the air that has been used in the combustion, as well as particles of ash sucked up by the draught of the chimney.

In time the fire burns clearly, the amount of flame becoming extremely small, and consisting mainly of carbon monoxide, and practically smokeless combustion is attained. No further pollution of the atmosphere takes place until more coal is fed on to the fire, whilst the incandescent fuel is radiating out the heat given by the combustion of the carbon, and is doing more heating work than at any other period.

Such details of chemical and physical action as I have attempted to bring before you seem absolutely superfluous to the lay mind, but until they are recognised it is practically impossible to arrive at any true solution of the difficulty.

Take an iron flask, half fill it with pieces of bituminous coal the size of peas, and heat it up to the highest temperature you can obtain with an atmospheric burner, and you will find that, as the heat penetrates the mass of coal, first white and then brown vapours distil from the mouth of the flask. Ignite these brown vapours, and you will see the same phenomena that are shown by the luminous flame above the fire; stop the flame for a moment by closing the mouth of the flask by a damp plug, and, having extinguished the flame, pass the brown vapours through a condenser, and you find that black liquid tar condenses and a clear, colourless coal gas escapes, which when ignited gives a luminous flame with little or no formation of carbon. Moreover, if, having ascertained this fact, you remove the condenser and re-ignite the mixture of gas and tar vapour, you find it gives a flame which steadily becomes less and less luminous, and finally assumes the character of a yellowish flame incapable of forming smoke, and from which no tar can be condensed.

This flame gradually dies away, and if the residue in the flask be examined, it is found to be ordinary gas coke, which when burnt in air gives no smoke or soot, and only such flame as is due to the formation of carbon monoxide by the passage of air through the incandescent carbon, and which, escaping from the mass, meets more air and burns with a small non-luminous flame.

From the fact I have brought before you several points are clear:—

(1) That the smoke-forming portion of bituminous coal is the hydrocarbons, which on destructive distillation form the tar.

(2) That the true coal gas contains but little of these, and can easily be burnt with smokeless combustion.

(3) That the residue left after the destructive distillation of the coal, *i.e.* coke, burns without the formation of smoke.

(4) That tar vapour and white smoke escape in the form of minute vesicles, which will float in air until burst by violent contact with some surface, on which they then deposit as tar.

(5) That what we speak of as smoke consists of a mixture of (*a*) tar vapour; (*b*) water vapour; (*c*) tarry carbon particles; (*d*) products of combustion other than water vapour; (*e*) fine particles of ash.

Amongst the gaseous products of combustion also are

to be found sulphur compounds, such as sulphuretted hydrogen and sulphur dioxide, the first formed during the distilling period when coal has just been fed on to the fire, and the latter during the combustion. Both these compounds are due to the sulphur always present in the coal, and whilst the former blackens white-lead paint and tarnishes silver, the sulphur dioxide, dissolving in water, oxidises to sulphuric acid, which is far more actively injurious, corroding and destroying metal work, retarding the growth of vegetation, and finally killing it.

Smoke thus formed finds its way from the chimney into the atmosphere, and is rapidly diffused through the air by means of the air currents, and it is manifest that if there were no means of removing it the air would soon become perfectly opaque from its accumulation in large quantities. When, however, rain falls, it rapidly washes the air free from such suspended solid and liquid impurities which constitute the visible portion of smoke. Snow is even more efficacious than rain in doing this; where the snow has fallen on the glass roof of a greenhouse it will be noticed that when it melts it leaves behind a black deposit consisting of the solid matter which it has collected during its passage through the air. An analysis of a deposit of this character formed on the glass roofs of some orchid houses at Chelsea gives a very good idea of the constituents of these solid impurities:—

	Per cent.
Carbon	39·00
Hydrocarbons	12·30
Organic bases	1·20
Sulphuric acid	4·33
Ammonia	1·37
Metallic iron and magnetic oxide	2·63
Other mineral matter, chiefly silica and ferric oxide	31·24

Water not determined.

In cases where long drought prevents the rapid clearance of the air by this means, the heavier of the solid particles settle by gravity, whilst the particles of carbon and carbonaceous organic matter are slowly oxidised by the oxygen and ozone into carbon dioxide, in which form vegetation removes them from the air.

The solid particles suspended in air are, however, by no means confined to the products of our improper use of bituminous fuel, and mineral matter from the dust of our roadways and organic matter from animal and vegetable life all play their part in rendering town air deleterious to health; but it is the smoke "dirt" that is the most injurious factor.

The smoke from our grates is naturally discharged at a lower level than that from the factory shafts, with the result that it probably has a greater effect on our general health and buildings than the higher layers of smoke, which travel for miles with the wind and which act more by darkening the sky and cutting off the sun's rays; and it is also clear that the low-level smoke will not extend so far from the point at which it is formed, as contact with buildings and vegetation rapidly rob it of the tar vapours, with the result that in a smoky town like Leeds it has been shown that at one mile out the solid impurities have fallen to one half, and at 2½ miles out to one-sixth.

Injurious as are the direct effects of smoke on health and property, they are small as compared with those brought about by dense fog, which may to a great extent be attributed to smoke, which acts partly by helping its formation and partly by retarding its dispersion.

Fog, whether it be in the form of white mist which is found in the country, or the yellow abomination which we know so well in London, is formed by the condensation of water vapour from the air, and this is brought about by any cause which rapidly cools a large volume of moist air. If, instead of the surface of the ground and the objects on it only being cooled the air for a considerable height above it is also lowered in temperature, then the moisture which is deposited from it, instead of forming dew, condenses in the air, forming minute vesicles that remain suspended and floating in the air, and constitute fog or mist. In pure air the mist so formed consists of little else than these minute bubbles of water, and has no irritating effect on the eyes or lungs. In a large town like London, however, the air is charged with an enormous number of minute particles, the heaviest of which settle on a horizontal or roughened surface in the form of dust, whilst the lighter particles continue floating in the air. These particles consist of a heterogeneous collection of all kinds of matter, amongst which "smoke" particles bulk largely, constituting more than one half. All these floating solids cool with great rapidity on account of the smallness of their size, and in doing so cause the rapidly cooling air to deposit moisture upon them, and so aid in the formation of the town fog, which appears long before the country mist.

The air of towns in which much coal is used also contains the volatile tarry matter distilled off during the imperfect combustion, and this, condensing with the moisture, coats it on the outside with a thin film, which does much to prolong the existence of the fog, as when the temperature of the air again rises the clean mist again evaporates into the atmosphere, but the tar-coated yellow fog has its power of evaporation retarded to an enormous extent. Experiments made by Sir E. Frankland show that the evaporation of water in dry air is reduced nearly 80 per cent. by blowing some smoke from burning coal on to its surface.

The statements made as to the enormous waste of fuel in the escaping smoke are, I think, often much exaggerated. In point of fact, the carbon wasted as soot is extremely small, and varies in smoke with the state of the fuel which is fed on to the fire. Under the ordinary conditions experienced in an open fire grate, in which the fire has just been made up with bituminous coal, the heavy smoke escaping will contain, on an average, 1½ per cent. of the total weight of fuel consumed, and as the temperature of the mass gradually increases this falls to less than ½ per cent.

A greater waste of the thermal value of the fuel takes place in the formation of the smoke, *i.e.* in the heat rendered latent in bringing about the decomposition of the coal, and the volatilisation and escape unburnt of the tar vapours formed.

Having gained an idea of the causes which give rise to smoke from the domestic hearth, we can now review the proposals which have from time to time been made for its prevention, and which may be classified under the headings:—

(1) The use of bituminous fuel in special grates.
(2) The use of solid smokeless fuel.
(3) The use of gaseous fuel.
(4) The combined use of gas and coke.
(5) Central heating by steam, water, or hot air.

In considering the claims of these various methods we must remember that the English open fire is undoubtedly the most comfortable and wasteful method of heating that could be adopted; but although by far the largest proportion of the heat escapes up the chimney, we must clearly bear in mind that this very factor makes it a most important engine of ventilation, and that at this time, when the ventilation of our middle-class houses is chiefly left to the jerry builder and the open fireplace, it is an important factor of health. Moreover, it heats the room in the only healthy way, that is, the radiant heat from it does not directly raise the temperature of the air, but is radiated to the floor, walls, and furniture in the room, which again part with their heat slowly to the air in contact with them and to the inhabitants, so that the walls and other solid matters in the room are at a higher temperature than the air.

Apart from its being more healthy to breathe cool than hot air, there is another important point to consider. The normal temperature of the body is 98° F., or 36·8° C., and this temperature is maintained by the slow combustion processes going on in the body. By the laws of radiation a heated surface parts with its heat more or less rapidly according to the temperature of the surrounding bodies, so that if a person be sitting in a room filled with warm air, but near a wall colder than the air, his body will rapidly part with heat by radiation to the wall, and a sensation of chill is the result; but with the open fire this is never the case, as the radiant heat from the fire heats the walls of the room to a temperature higher than that of the air. But when a room is heated by means of hot-water pipes or warmed air, the walls not being heated

in the same proportion, although the air may feel warm the walls will remain cold, so that the heat of the body would pass by radiation to the walls and give rise to a chill.

If, therefore, one can retain the chief characteristic of the open-fire heating by radiation, and eliminate the smoke production and excessive waste of heat up the chimney, we should have the ideal conditions for house-warming.

Enormous improvements have been made in the domestic grate during the last fifteen years both from the artistic and economic point of view, and whilst with the older forms it was not unusual to find a coal consumption of 7 to 8 lb. of coal per hour, this quantity has been reduced in the more modern forms to about one half, and this in itself has been an important step in smoke reduction; but grates have long lives, and the capital outlay of putting in new ones results in the modern forms being chiefly found in new houses. There have been many attempts made to construct grates for the smokeless consumption of coal, but it is found in practice that when once the heavy carbonaceous smoke is produced it is very difficult again to burn the carbon particles completely, as the dilution caused by the large volumes of nitrogen present prevents their easy combination with the oxygen of the air; and there is no doubt that the best methods of preventing smoke from bituminous coal is to feed on the fresh coal only in very small quanties, and to supply the top of the fire with a sharp draught of hot air. Under these conditions complete combustion of escaping hydrocarbons is ensured, and very little carbon is allowed to be liberated in the solid form. In order to do this, however, the stove has to be to a certain extent closed in, which is a drawback, and it is also found that no grate for bituminous coal is absolutely smokeless.

Stoves have been constructed in which the coal should be supplied to the bottom of the fire, so as to keep the top bright and clear, all the smoke having to pass through the clear fire above, where it is decomposed. Such grates are by no means novel, as one of the best was the "Arnott," and must be more than sixty years old; but for some reason they have never been popular with stove manufacturers, with the result that they have never reached the public, otherwise they are efficient and economical.

The great factor in making special forms of grate an ineffective solution of the smoke problem is that it involves large capital outlay on the part of the consumer, and my own experience is that unless the consumer can become a reformer without expense or extra trouble, the majority will talk but never act, and it is for this reason that the use of solid smokeless fuel, which can be used in all existing grates, appears the most likely solution of the great question.

Smokeless solid fuels may be classified as:—

(1) Coal which has been carbonised at a high temperature, so as to drive out practically all the volatile matter, and this class is represented by gas coke and Coalexld.

(2) Coal which has been partially carbonised so as to distil out the smoke-forming constituents, but to leave enough volatile matter to give a non-luminous flame and easy ignition, as seen in coalite and carbo.

(3) Non-bituminous coal, such as anthracite.

Coke, the solid product of high-temperature distillation, has never found favour with the middle and upper classes as a domestic fuel, owing to prejudice against it because of its being somewhat difficult to ignite and not burning freely, and its chief market has been for steam-raising and other manufacturing purposes, very little finding its way into the householder's grate. The result is that, had not carburetted water gas offered a convenient and economical way of using it in the gas works, many companies would have found great difficulty in keeping up the price during the years that coal was cheap.

It must be remembered, however, that during the past three years the great gas industry has been in a transition stage, and England is slowly following the lead of the Continent in recognising the fact that great economies are to be found in carbonising coal for gas-making in larger charges than have ever before been attempted, and the introduction of vertical and oven retorts is undoubtedly a step in the direction of making a coke which shall be more fitted for a domestic fuel than the overheated product made in the horizontal retorts of late years.

The large amount of attention centred upon the production of a smokeless fuel during the past three years has led to the introduction of several processes for improving the coke during gas manufacture, which, although leading to little or no improvement, have enabled the product to be sold under a fancy name, and have done a certain amount of good by inducing consumers to try under another name the coke which prejudice would have damned untried.

The second class of smokeless fuel, and the one which many scientific men look upon as the most promising solution to the smoke problem, owes its inception to Colonel Scott Moncrieff, who many years ago suggested the use of a half-coked coal as a fuel supply, and tried to make a commercial article by carbonising coal at the ordinary gas-retort temperature, drawing the charge when half the usual volume of gas had been distilled out from it. Two factors, however, led to failure, the one being that the time was not ripe, and the second that the means by which he proposed to carry out his entirely admirable idea, being dependent upon the ordinary gas-works practice, had to be carried out under certain conditions which led to a want of uniformity in the fuel, and to certain difficulties which those who tried to make it failed to overcome.

The idea, however, of a semi-carbonised coke which should still contain enough volatile matter to give easy ignition and a cheerful flame without any smoke, was independently revived under the name of "Coalite."

This differs from the fuel proposed by Colonel Scott Moncrieff in that, instead of shortening the period of carbonisation at a high temperature, the temperature is reduced to one half the ordinary, and is continued in suitable retorts until a uniform coke, containing 12 to 15 per cent. of volatile matter, is formed. In both processes there is the fatal defect—from a gas manufacturer's point of view—that less than one half the volume of gas is obtained per ton of coal, and as the all-conquering career of the incandescent mantle has rendered a high candle-power gas unnecessary, the rich gas yielded is not looked upon as an equivalent attraction.

The coalite process has the great advantages over the older process that the fuel is of greater uniformity, and that the yield of tar is doubled instead of being decreased, and is greatly enhanced in value.

Coalite has created so much interest that, as was only natural, the Moncrieff process was revived, and the product is well known under the name of "Carbo."

Coalite appears at present to be labouring under difficulties, but I am convinced now, as I was when I first examined the process, that when its manufacture is properly handled coalite will be the ideal fuel, and will not only solve the smoke problem in the easiest possible way, but will also be an important economic advance in our treatment of coal.

The use of a non-bituminous coal like anthracite would result in smokeless and very hot combustion, but here again the objection is that stoves with a special draught would have to be used, and the initial cost would prevent its use ever being adopted, besides which any great demand for this kind of fuel would at once send up the price to a prohibitive figure.

If the consumer can be induced to take the trouble, a very good semi-smokeless fuel can be made by using a mixture of two-thirds coke to one-third coal, and instead of piling up the grate with cold fuel when the fire burns low, to add the fresh fuel frequently in small quantities, so as to prevent the deadening of the top heat of the fire: but this is diminishing, not killing, the evil.

Leaving the smokeless solid fuels, which I believe will in the future play a very big part in the cleansing of town air, we now come to the gaseous fuels, and here at once we have ready to hand a solution of the difficulty in the use of coal gas. Gas fires, gas cookers, gas water-heaters, gas engines, have all been developed to a point which leaves no valid excuse for overlooking their claims, and ever since Bunsen in the early 'fifties gave us the atmospheric burner, in which non-luminous combustion is obtained and smoke rendered impossible, coal gas has

steadily progressed in favour for heat and power as well as light, until at the present time nearly as much is used for the one as for the other.

What, then, stands in the way of its universal adoption? First and foremost, initial cost crops up, as although much has been done by the companies in popularising gas stoves by letting them out on hire, by easy payment systems, and by looking after their maintenance, the consumers must pay something, and that is sufficient to damp their ardour as smoke reformers. Secondly, gas is a little more expensive for continuous heating than coal, although when used for short periods, as for fires in bedrooms, &c., the fact that you turn it on when you want the fire and turn it off when it is done with brings the fuel cost to nearly the same as coal, whilst in such places as Widnes and Sheffield, where the price has been reduced to a minimum for heat and power, the gas engine and gas fire well hold their own.

The chief sentimental objections to the gas fire—its non-pokerbility and one's not being able to throw cigar stumps and ash into it—are disposed of by a suggestion made first, I believe, by Sir W. Siemens some thirty years ago, and that is to decompose bituminous coal into coke, tar, and gas in our gas works, and to reunite the true heat producers, coke and gas, in our fire grates sans the smoke-producing tar—to do, in fact, with coal what was done by Chevreul a century ago with tallow, when he converted the tallow dip into the composite candle.

All the initial outlay needed for this is to fit the atmospheric burner arrangements of the gas stove to any ordinary fire grate, so arranging them that they can be made to swing back clear of the fire when they have done their work of bringing to bright combustion the gas coke used as fuel in the grate. This has always seemed to me to be the best economic method of using the products of gas manufacture, because it would be impossible to use either gas or coke alone to entirely supplant the use of bituminous coal; a market must be made for the by-products if prices are to be kept down and, as we hope, still further reduced, but if the use of gas and coke could both be increased, the gas manager could afford a diminution in the price of tar from over-production, as he has already ruined the tar market by overheating his retorts, and so loading the tar with free carbon and naphthalene as to make it nearly worthless.

As I have before pointed out, to my mind the best solution of the dual question of the most economical use of coal and the cleansing of our atmosphere is to be found in low-temperature carbonisation and the production of such fuels as coalite, because every constituent of the coal is utilised in the best way; but when we see how little expense and personal trouble is needed to attain smokeless combustion in other ways, it becomes evident that the mere provision of means to bring about the desired end is entirely insufficient. How can the societies interested in smoke abatement influence the hundreds of thousands of small consumers whose chimneys make the morning cloud; they may make their doctrines felt in the West End, but will they ever touch the seething population of the workers' quarters of the town?

One is gravely told that legislation should be passed dealing with the question, and that the use of bituminous coal should be forbidden; but I think this is scarcely feasible, and unless we revert to the conditions of 1306, when a citizen of London was executed for using bituminous coal, I doubt its being effective; but I do believe that if a future Chancellor of the Exchequer would put a 5*s.* tax on bituminous coal, exempting that used for gas-making, smokeless fuel manufacture, and for use by those burning it in smoke-preventing forms of grate or furnace, the question would quickly be solved, coal economised, and smoke abolished.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

SIR T. CARLAW MARTIN, editor of the *Dundee Advertiser*, has been appointed by the Lords of the Committee of Privy Council on Education in Scotland, director of the Royal Scottish Museum, Edinburgh.

PROF. G. R. THOMPSON, professor of mining, University of Leeds, has been appointed professor of mining at the South African School of Mines and Technology, Johannesburg, and principal of the college.

THE Department of Agriculture and Technical Instruction for Ireland has issued in pamphlet form an illustrated account of technical instruction in Londonderry, by Mr. G. E. Armstrong, principal of the Londonderry Municipal Technical School, which was published recently in the Department's Journal (vol. xi., No. 1).

THE report of a higher education subcommittee of the London County Council Education Committee, recently prepared, provides interesting information as to the allocation of grants to secondary schools aided by the Council. The income of aided secondary schools is derived from four main sources:—endowment, Board of Education grant, fees, and grants from the Council. The actual receipts for the school year 1909–10 under the four headings in order were 45,132*l.*, 52,326*l.*, 101,256*l.*, and 37,398*l.*, making a total of 236,112*l.* The estimated receipts for 1910–11—for the aided schools, which number forty-two—are, under the same headings, 46,589*l.*, 52,653*l.*, 97,181*l.*, and 38,203*l.*, amounting to 234,626*l.* The amounts mentioned under fees include the fees of London County Council's scholars, which in the forty-two schools mentioned were in 1909–10 37,938*l.*, and are estimated for 1910–11 at 37,144*l.* It will thus be seen that the total Council grant to aided secondary schools in London was in 1909–10 75,334*l.*, and will be in 1910–11 75,347*l.*

A COPY of the annual report of the 114th session of the Glasgow and West of Scotland Technical College, which was adopted by the governors last September, has been received. The progress of the college in regard to the number of students, as well as standard of work, continues to be satisfactory. While the number of individual evening students has increased in five years by 30 per cent., class enrolments and "student hours" have increased by more than 45 per cent. The fourth and last section of the new buildings has now been completed, and provides accommodation for the department of textile manufacture. The new school of navigation, to which the Glasgow City Educational Endowments Board has undertaken to make an annual subsidy of 500*l.*, has now been organised and opened. In their report the governors acknowledge the receipt of additional grants, amounting to 26,866*l.*, from the Scotch Education Department towards the building and equipment fund, and a grant of 3000*l.* from the trustees of the late Mr. Alexander Fleming.

THE eighteenth annual distribution of prizes and certificates was held at the Borough Polytechnic on Monday, December 19. Mr. J. Leonard Spicer (chairman of governors) presided, and in the course of his opening remarks referred to the great progress made by the institute during the year, the record number of class entries being more than 5000, showing an increase of more than 500. That the work was appreciated was shown by the numerous visits paid by persons from all parts of the world interested in education, and as a result of one of these visits a request had been received from the High Commissioner to the Australian Commonwealth for a set of specimens of metal work executed by the boys of the day school, and the Japanese Commissioner, on behalf of his Government, applied for the metal work of the boys' day school, the specimens from the printing classes, and the work of the oils, colours, and varnish department, that had been displayed at the Japan-British Exhibition. The principal, Mr. C. T. Millis, reported the satisfactory examination results, and stated that thirteen medals had been gained in examinations conducted by the City and Guilds of London Institute, the Royal Society of Arts, and other public bodies. Lord Lytton urged the students of the polytechnic to do their utmost to realise the ideals which the founders of that institution had in mind when the polytechnic was first established. Was there ever a more pathetic sight, he asked, than to see a man who had suffered all through his life from lack of opportunity, and he thought the polytechnics were established with the object of equalising opportunities for all in the competition in life. The polytechnics should in addition stimulate among the students a sense of the duties and responsibilities of citizenship.

JUDGING from a speech by Mr. Beeby, the Minister of Public Instruction at Milthorpe, on November 3, a report of which has reached us, education in all its grades is likely to receive generous treatment from the new Labour Government in New South Wales. Among other developments in education which it is proposed to foster is the inauguration of continuation and trade schools, and a large extension of technical schools, with the view of keeping boys and girls who leave school at an early age to enter "blind-alley" employments under observations and under the influence of active and interested minds much older than their own. New regulations as to the high schools are under consideration also. Their main object is to establish a well-defined course of secondary education in certain selected schools, and in that way to abolish the present unsatisfactory position of superior public schools in which children get a smattering of education without any definite result. These regulations provide for the establishment of high schools, the abolition of tuition fees—the periods and character of instruction in high schools and superior public schools differentiating the two types—the institution of certificates of attainments, and the localisation of scholarships within districts, to secure their distribution throughout the States. The Government believes also that reforms in the constitution of the university are necessary before any serious increase in State subsidies is considered, and this matter is under consideration. As regards the question of compulsory attendance at continuation and trade schools, the Government proposes to face an alteration of industrial laws to provide for the shortening of the working hours of boys and girls up to the age of eighteen, and their attendance at school for a certain number of hours each week. It is satisfactory to find that the new Government of New South Wales believes that the people of this State will support cheerfully any proposal for a large increase in the education vote so long as the money is spent wisely, and will make every effort to carry out the reforms indicated.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, December 13.—Mr. G. A. Boulenger, F.R.S., vice-president, in the chair.—E. S. **Goodrich**: The segmentation of the occipital region of the head in the batrachia Urodela. This paper was based upon the author's studies of the development of the head region of the Axolotl (*Amblystoma tigrinum*). The head of the Axolotl contained three segments behind the auditory capsule. Three metaotic somites were developed in these segments, of which the first soon disappeared, and the second and third contributed to the formation of the temporal muscle. To the first segment belonged the glossopharyngeal nerve, to the next two the vagus. The occipital condyles were developed between the third and fourth somites. The two hypoglossal roots corresponded to the fourth and fifth metaotic segments, and passed out in front of the first and second vertebræ. In the Amniota all these segments were included in the head. The skull of an amphibian was thus shorter than that of a mammal, yet the condyles were homologous in the two animals. The shifting backwards or forwards of the condyles was brought about, not by the inter- or ex-calation of segments, but by a transposition from one segment to another. The shifting of the condyles was comparable to the transposition of the limbs on the trunk-segments.—Oldfield **Thomas**: The mammals of the tenth edition of Linnæus: an attempt to fix the types of the genera and the exact bases and localities of the species. It was shown that by the use of tautonymy the types of nearly all the Linnæan genera could be definitely fixed, the conclusions arrived at by this means agreeing in most cases with common usage. The type of Simia, however, would not be *S. satyrus*, but *S. sylvana*, and of *Dasypus D. novemcinctus* instead of *D. sexcinctus*, the consequences of which changes were pointed out. Pygathrix, as represented by the two species *nemaeus* and *nigripes*, was shown to be generically distinct from Presbytis, so that the latter name still remained available for the ordinary Langurs. Changes in specific names, due to a complete examination, were shown to be less numerous than might have been expected, while the stability of mammalian nomenclature was much increased by avoiding the danger of what such an examination might lead to. Type localities, derived from the original authors quoted by Linnæus, were defined for a considerable number of the species.—Dr. W. E. **Hoyle**: Report of the International Commission on Zoological Nomenclature. A discussion of the report followed on the portion relating to the formation of an official list of most frequently used zoological names. The feeling of the meeting was very strongly in favour of the International Congress giving its authority to the formation of a list of zoological names, the significance of which should not be altered by application of the rules of the international code. It was unanimously agreed to accept the action of the Congress if it would adopt this course.

Royal Meteorological Society, December 21.—Mr. H. Mellish, president, in the chair.—Captain C. H. **Ley**: Report on balloon experiments carried out at Blackpool in the early part of the year. The proposal was to employ balanced pilot balloons, which, floating in a current with no upward or downward hydrogen velocity, would represent the motion of a particle travelling in that current. Difficulties, however, arose which prevented the scheme being carried out as originally planned. Ultimately, a hydrogen balloon, or twin-system of hydrogen balloon and heavy satellite, was so valved as to have a large lift at first, but to continuously lose gas under the action of a leak until a certain point is reached, when the valve closes, when in accordance with previous adjustment it is nearly in equilibrium. The vertical motion of a fresh wind blowing over a flat country is very slight as a whole, but subject to marked variation on special occasions. In the lowest stratum in the late afternoon there is frequently a large descending current. The apparent effect of a river is to check the wind velocity and cause a downward movement of air over the whole area of the river valley.—Captain C. H. **Ley**: The meteorological significance of small wind and pressure variations. In this paper the author compared the "yawings" of the wind at Blackpool with the small variations of atmospheric pressure as recorded by the microbarograph.—Dr. Wilhelm **Schmidt**: Atmospheric waves of short period.

Institution of Mining and Metallurgy, December 21.—Mr. Edgar Taylor, president, in the chair.—F. **Gillman**: Malaga magnetites. In a previous paper the author suggested that the magnetites of Malaga, Spain, were originated by segregation from the peridotite magma, and the present paper was written to confirm this suggestion after a detailed examination of one characteristic deposit at Estepona. This deposit is intimately related to the serpentinised peridotite which constitutes the entire mass of the adjacent mountains, and is about half a mile distant from the nearest metamorphic or sedimentary rocks, and the results of work executed on the ore body serve to show that the deposit consists of serpentine, which is sterile above a certain line, and more or less ore-bearing below.—R. W. **Hannam**: A method of raising bore-casings from a pontoon. This brief note describes a simple method of withdrawing bore-casings from a river bed by means of the surplus buoyancy of native pontoons. A crowd of natives was employed to weigh down the pontoon, and the bore-casing was secured to it when thus depressed. At a given moment the natives sprang overboard, and the buoyancy of the pontoon was sufficient to withdraw the bore-casing.—H. C. **Bayldon**: Notes on Chilian mills in Russia. The author provides a useful and instructive treatise on the slow-running Chilian or "edge-runner" mill invariably used in Russia for crushing gold ores as a preliminary to amalgamation, &c. After a brief historical summary the paper deals with a description of the standard type of Chilian mills now in use, and of the milling methods adopted in Russia, and this is followed by notes on an improved type of Chilian mill and milling plant recently introduced. The descriptions are suitably illustrated, and there are ample statistics relating to mills and their efficiency. The author is of opinion that, if the same amount of thought and attention were devoted to the development of this type of mill as has been given to the heavy stamp-tube mill combination in South Africa, it would prove a serious rival and give a product nearer to the ideal aimed at on that goldfield.

MANCHESTER.

Literary and Philosophical Society, November 15.—Mr. Francis Jones, president, in the chair.—Dr. W. **Makower** and Dr. S. **Russ**: Note on scattering during radio-active recoil. During experiments on the recoil of radium B from radium A, not only did a surface directly exposed to the recoil stream become active, but surfaces situated outside the direct stream also received active deposit. It was thought that these effects were due to scattering from the surfaces upon which the recoil atoms fell, and experiments were made to test this. These were carried out in a high vacuum, and a plate was mounted in such a way that it was outside the recoil stream coming from an active wire coated with radium A, but so that recoil atoms scattered from a copper reflector could reach it. When the plate was examined it was found to be active, and by measuring its rate of decay with an α-ray electroscope, more than half of the active matter proved to be radium C, and not radium B. This result can be explained if, when the radium B impinges on the reflector, a small portion of it is scattered on to the plate, but the greater part remains on the reflector and subsequently gives rise to radium C, a small fraction of which is then directly projected on to the plate.—D. M. S. **Watson**: Upper Liassic Reptilia. Part iii.: Microcleidus and on the genus Colymbosaurus.

November 29.—Mr. Francis Jones, president, in the chair.—Prof. A. **Schwartz** and Philip **Kemp**: Some physical properties of rubber. Pure rubber strip which has not previously been extended has a large coefficient of linear expansion when tested under loads just sufficient to keep the strip straight. The behaviour of rubber when heated under tension was found to be more complex than had previously been supposed. The previous history of the rubber as to whether it has been previously extended or not largely affects the result. The modulus of elasticity of the rubber probably changes with load and temperature. Considerable change takes place in pure rubber when rested in air for some time at normal temperatures, the strips, which were originally translucent and flexible, becoming opaque and hard. An opaque, hard, and comparatively inextensible condition can be obtained by slightly warming a pure rubber strip and rapidly extending it as far as possible by hand. On keeping it extended thus for a few seconds and then removing the tension it will be found that the rubber remains extended in an opaque condition, but can be brought back to its original dimensions and condition by the application of slight heat. The mechanical hysteresis of rubber has been studied and applied to the testing of rubber. The hysteresis machine was described. A test-piece of rubber, subjected to a series of complete cycles of extension and retraction, was shown to increase in length, according to a logarithmic law, with respect to the numbers of the cycles. The slow stretch of rubber under a constant load also follows a logarithmic law with respect to time. The work done in extension, in retraction, and in the rubber itself, was shown to be proportional to the cross-sectional areas of the specimens.

DUBLIN.

Royal Irish Academy, December 12.—Dr. F. A. Tarleton president, in the chair.—G. H. **Pethybridge** and Paul A. **Murphy**: A bacterial disease of the potato plant in Ireland, and the organism causing it. The authors describe a bacterial disease of the potato plant of frequent occurrence in Ireland, and give an account of the organism which they isolated from diseased plants, and with which successful inoculations were carried out on healthy plants and tubers. It is a multiflagellate peritrichous bacillus, liquefying gelatine and producing decay in the living tissues of a variety of plants in addition to the potato. It resembles in many respects other organisms which have been found causing similar diseases in potatoes both in the Old and New Worlds, but does not appear to be identical with any of them. The name *Bacillus melanogenus* is proposed for it.—A. W. **Stelfox** and Robert **Welch**: A list of the land and fresh-water Mollusca of Ireland. In the introduction the authors give a short *résumé* of the work which has been done in this branch of natural history in Ireland from the time of Captain Thomas Brown to the present day. This includes a list of species added to the Irish molluscan fauna since the publication of Dr. Scharff's valuable work in 1892. The paper is divided into three parts; first comes the list proper, which includes only *bona fide* records, *i.e.* records which are backed up by specimens; secondly, a list of doubtful and erroneous records; and, lastly, a complete list of all species which are known to have been introduced into Ireland in recent years. These are mainly confined to greenhouses and nursery gardens. In the list proper the authors give notes on the principal variation of many of the species, especially that variation which tends to be of interest to those who study the geographical distribution of plants and animals. A full bibliography accompanies the paper.—H. Wallis **Kew**: A synopsis of the false scorpions of Britain and Ireland. The arachnidan order Pseudoscorpiones is represented in the British Islands by twenty-two species, one of which, unknown in Britain, is confined in Ireland to the extreme south-west.

DIARY OF SOCIETIES.

MONDAY, JANUARY 2.

ARISTOTELIAN SOCIETY, at 8.—The Standpoint of Psychology: Benjamin Dumville.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Determination of Sucrose (Cane Sugar) in Sugar Factory Products by Clerget's Process using Invertase as Hydrolyst: J. P. Ogilvie.—The Testing of Incandescent Mantles: J. H. Coste and W. E. F. Powney.—Radiation Errors in Flow Calorimeters: J. H. Coste and B. R. James.

THURSDAY, JANUARY 5.

RÖNTGEN SOCIETY, at 8.15.—The Radioactivity of Thorium: Prof. Rutherford.

CONTENTS.

THURSDAY, JANUARY 5, 1911.

A CONTRIBUTION TO THE HISTORY OF EVOLUTION.

The Coming of Evolution. The Story of a Great Revolution in Science. By Prof. J. W. Judd, C.B., F.R.S. Pp. iv+171. (Cambridge Manuals of Science and Literature.) (Cambridge: University Press, 1910.) Price 1s. net.

SO much has been written within the last few years about the history of evolution and its founders that the first question that arises on meeting with the title of this new work is whether it is possible to say anything new upon a subject which has already been dealt with so fully by the founders of the doctrine themselves, or has been handled from so many different points of view by the historians of science and philosophy. The title of the little volume under notice need not, however, act as a deterrent, because in the first place the name of the author will command the confidence of scientific readers, and, in the next place, because, in the words of the general prospectus, the series of small manuals to which it belongs is

"not intended primarily for school use or for young beginners. The educated reader often experiences a difficulty in obtaining short books in which recent discoveries or modern tendencies are treated in a semi-popular and broad style."

With the objects thus set forth we are in complete sympathy. There is ample scope, not to say a crying need, for the authoritative enlightenment of the public mind on scientific questions. With respect to the present contribution to the series it is only necessary to remind readers of the fact that Prof. Judd is among that small and diminishing group of men who can claim to have been personally acquainted with Scrope, Lyell, Darwin, and Huxley, and whose qualifications for instructing the public on that subject which has been placed in his hands are therefore of an exceptionally high order.

By "The Coming of Evolution" the author means both the preparatory work of the great pioneers in geology, such as Hutton, Scrope, and Lyell, and the history of the revelation of the working mechanism of organic evolution by Darwin and Wallace. Of course, there is not much scope for novelty as regards the main facts in such a work since most of the materials have been public property for many years. It is in the handling of the material, in the presentment of the history and in the personal touches which here and there enliven the story with actual reminiscences that will be found the chief interest and value of this fascinating little book. As a geologist it is but natural that the author should bring into prominence the achievements in that domain, and especially those of his own master, Lyell, whom he places as the founder of inorganic evolution side by side with Darwin as the founder of organic evolution. With what feelings do we now read of the great struggle—rapidly passing into ancient history—between uniformitarianism and catastrophism, of the pitying contempt with which many of his contemporaries regarded "poor old Lyell's fads," and of the nervous caution which at that period was necessary in order to circumvent the *odium theologicum*. It may have been excusable in those days to regard the uniformitarianism of Lyell as synonymous with evolution. Yet it must not be forgotten that this inorganic evolution deals only with the geological record. Whether catastrophism in any form occurred during the period represented by that record is a matter of geological evidence, and it is with the geologists that the interpretation of the evidence rests. The old view of terrestrial catastrophism has certainly been slain; nevertheless, after the heat of the fray, are we not justified on calm consideration in rejecting the view that catastrophism and evolution are antagonistic and irreconcilable? The shedding of moons by planets, the outburst of temporary stars and other cosmical phenomena of castastrophic magnitude would appear to indicate that nature's operations are not always carried out by retail instalments. Evolution *per saltum*, so far as the geological record teaches, may be ruled out; nevertheless there was a period antecedent to that record, and catastrophic development must be reckoned with as part of the evolutionary machinery of the cosmos.

Thoughts of this kind and many other suggestive ideas will be prompted by the perusal of Prof. Judd's condensed history. There are many points upon which the various classes of readers to whom the book appeals could enlarge, and there is very little scope for criticism in the usual acceptation of the term. Prichard, who in some measure forestalled Galton and Weismann, did not spell his name Pritchard. The statement (p. 155) that "the inheritance of acquired characters and similar problems were constantly present to Darwin's ever-open mind" may be challenged, because—to our everlasting regret—this question did not take an acute form until after Darwin's death. There is only one passing allusion to the subject in the "Origin of Species" (sixth edition, p. 33), where it stated that such "'variations' are supposed not to be inherited," but Dr. Francis Darwin informed the writer some time ago, when the passage was brought under his notice, that he was unable to throw any light upon the source of his father's authority for the statement, nor has the present writer been able to ascertain by whom this view was held in Darwin's time. Perhaps some of the readers of this notice may be able to supply the necessary information.

But these are only small points. From what has been said concerning the volume as a whole it is evident that we are indebted to the author for a most readable and instructive summary, which appeals not only to the educated public for which it is intended, but which ought to be read, and read carefully, by students of natural science. Prof. Judd, upon whom many of the present generation of geologists can now look as their teacher, survives as a living witness of that great campaign, carried on in the arena of science, which resulted in the overthrow of the ancient cosmogony and the demolition of that narrow teleology which hampered scientific progress in every

direction down to the middle of the last century. It is well that he has given us this short epitome with the history of modern evolution still fresh in his mind, for the present-day student is apt to forget the services of the great masters who fought and won on his behalf that battle which swept away the barriers interposed in the path of scientific progress by prejudice and bigotry, and opened up illimitable fields for cultivation by later generations.

R. MELDOLA.

EDUCATION AND ENVIRONMENT.

Educational Aims and Efforts, 1880–1910. By Sir Philip Magnus, M.P. Pp. xii+288. (London: Longmans, Green and Co., 1910.) Price 7*s.* 6*d.* net.

IT has been recently pointed out by a distinguished educationist how the opening of each of the last four centuries has been associated with far-reaching educational reforms, and how the beginning of the present century has seen for the first time a determined effort to grapple with the whole problem of national education in England, in all its grades, as one thing. The present moment, therefore, seems a fitting opportunity for Sir Philip Magnus to have collected together some of his more important contributions to educational progress, which have been rendered the more interesting and the more valuable by a prefatory series of essays dealing with several branches of educational activity.

It is, of course, easy to be wise after the event, and especially is this true in the subject under consideration, which, if it is regulated as it presumably is, or should be, by certain fixed principles, yet the factors on which these principles depend, and the data on which they must be founded, are so vague, so changeable, and so difficult of definition, that possibly much may be said in mitigation of the blunders which people in high places have made in the past. None the less, it is difficult to put forward a national defence for the neglect of educational reform on broad scientific lines, and so long as this sphere of national activity is regarded as the shuttlecock of party politicians, it is hopeless to expect a well-defined policy which will be conformable to the changing conditions of changing times.

When the history of that great movement which was started by the Education Act of 1870, and vitalised and broadened by the Act of 1902, comes to be written, after its effects have been properly defined and the results can be assessed, it will be seen more clearly than can at present be done the extent to which the nation is indebted to the labours of a body of men, who were responsible in a far larger measure than is commonly appreciated for the essentials of the reforms, and among the names of these assiduous workers that of Sir Philip Magnus will occupy a distinguished place. In some way he has been connected with nearly every branch of educational work during the last thirty years, and although in the earlier days of what may be termed the forward movement, he was frequently in the minority, events have shown that the minority is not always wrong, and it is due largely to the zeal with which he and others, whose names are not less prominent, pleaded for the recognition of environment as one of the essential factors in determining the aims and ideals of any educational policy, that so many of the latter-day reforms are due. The characteristic, however, which distinguishes the author of "Educational Aims and Efforts" from some few of his fellow-reformers, is a sense of proportion, combined with a breadth of outlook, which gives to his utterances a value denied to others.

To attempt in the small space at our disposal to deal in any detail with the subjects comprised in the present volume is out of the question. To do so adequately would involve a survey of the educational history of thirty years. The important part which Sir Philip played in the advancement of technical education is too well known to require notice, but in these days when the cultivation of manual dexterity and the practice of scientific method are beginning to be regarded as within the scope of the ordinary elementary school, it is interesting to recall some of the earlier utterances of Sir Philip Magnus on those points, made in the days of payments by results. Secondary education and university reform are also indebted to him in a large measure, and the views which he put forward in 1888 as to girls' education "demanding full and careful consideration from the point of view of suitableness to woman's wants, woman's occupations, and woman's mission in life," in spite of the progress which has been made in this direction in the last decade, hold with equal force to-day.

To those who take a broad view of education as something that is inextricably bound up with the social fabric, the essay on "Social Changes and School Work" will be regarded as perhaps the most important in the whole volume, and one cannot but recognise, in spite of the controversial issues which it raises—the consideration of which would demand an essay in itself—that the great upheaval of late years in the social condition of our wage-earning classes "renders it necessary that we should reconsider by the light of these changes the foundations on which our present system of education is raised." From the point of view of teacher and administrator alike the problem is rapidly entering on a new phase; and although no one can predict with certainty what the next decade may bring forth, it seems clear that, in the clash of opposing tendencies, the attitude of uncompromising hostility to the larger and more complex requirements of modern conditions and civic responsibilities must give place to a spirit of scientific inquiry as to the most effective and economic method of coordinating educational aims with national ideals. Education is at present far from being an exact science; but there is no reason why it should remain an aimless experiment of misdirected zeal with the welfare of the rising generation.

We may perhaps be allowed to express the hope that the author will return to this problem at an early date, and in the meantime can only trust that the essay will receive that earnest consideration which it demands in view of the rapidly changing phases of social life and of the child's altered relation to the State.

F. H. N.

ENERGETICS AND MODERN PROBLEMS.

Die Forderung des Tages. By Wilhelm Ostwald. Pp. vi+603. (Leipzig: Akademische Verlagsgesellschaft m. b. H., 1910.)

IN Goethe's "Maximen und Reflexionen" there occurs the passage: "Versuche deine Pflicht zu tun, und du weisst sogleich was an dir ist. Was aber ist deine Pflicht? Die Forderung des Tages." The author of the present volume tells us that this passage expresses the spirit in which he has from time to time, particularly during the last few years, attempted the solution of problems quite outside the sphere of his original scientific activity. These problems cropped up in the course of the day's work, and, so far as the author was personally concerned, imperatively demanded a solution. The numerous articles and speeches here collected represent Prof. Ostwald's views on the most varied questions, such as personality, immortality, the relation of art and science, the theory of happiness, science and technology, duelling, international languages, and educational reform. These and many other topics are discussed in a highly stimulating manner, the originality of the author's argument being equalled only by the charm of his style and the wealth of illustration which he has at his disposal. If one accepts the definition of a professor as given by "Fliegende Blätter"—"der Professor ist ein Mann welcher anderer Meinung ist"—it may readily be granted that the author, with his refreshing novelty of view, has fully earned the title.

The point of view from which all problems are regarded is the one natural to the apostle of energetics, whose attitude towards the more general questions of philosophy and psychology has already been outlined in these columns (Nature, 1902, vol. lxv., p. 265). As the years have passed, however, Prof. Ostwald has been led to study the bearing of energetics on questions which touch more closely the life of the modern community, and are certainly of greater interest to the ordinary student of science and scientific method.

If, with the author, we measure culture by the extent to which the various sources of energy are economically utilised for human purposes, then it is natural to test the claims of every custom, every social organisation, and every educational system by the inquiry, How far does it contribute to the economical utilisation of energy? It might be supposed that the mental attitude of one who applies this test to all human endeavour is hopelessly utilitarian. But this is not true of Prof. Ostwald, who is concerned to find a place in his scheme of things for the higher and less immediately practical forms of man's activity. In this connection the question of the utility of works of art is of great interest. Prof. Ostwald, it appears, makes a hobby of painting, and we may be sure that he would at once forbid himself this activity if he considered it to involve a waste of energy. What, then, is a work of art, say a great painting, from the point of view of energetics? According to the present volume, the social value of such a work of art depends on its catalytic action, on its effect in making us better and happier beings, and so contributing to the more efficient transformation of energy in our daily tasks. This point of view is greatly in advance of the ultra-materialistic one from which a great painting is merely so much canvas, so much oil, and so much pigment, but it is doubtful whether the comparison with catalysis is anything more than a mere analogy.

The prominence still given to the study of languages in schools is condemned in no measured terms, and the time devoted to Latin and Greek is described as a sacrifice to a superstition. It is quite truly pointed out that the learning of even a modern language, with its innumerable exceptions to rules, tends to destroy the child's natural sense of logic and to unfit it for any future scientific work. From this position it is but a step to the advocacy of an artificial international language, which shall be "synthesised" on a thoroughly logical plan, and shall obviate the necessity of learning foreign languages. It is the economy of energy to be secured in this way that has led Prof. Ostwald to take a prominent part in urging the adoption of Ido, a simplified form of Esperanto.

"Die Forderung des Tages" is pervaded by a genial optimism, based on the belief that the future of the race is in the hands of science alone. The optimism is welcome, although one might be inclined to argue about the grounds for it. It may be noted only in passing that Prof. Ostwald's belief leads him to the curious conclusion that the chauffeur belongs to a distinctly higher order of being than the "cabby."

Throughout the book there are scattered many delightful reminiscences of the author's experiences at home and abroad. These only add to the interest and charm of a volume which is well worth reading whatever one may think of energetics.

J. C. P.

THE INDUSTRIAL REVOLUTION.

Industrial England in the Middle of the Eighteenth Century. By Sir H. Trueman Wood. Pp. xii+197. (London: J. Murray, 1910.) Price 5s. net.

WE have in the volume before us an extremely interesting sketch, expanded from an address by the author given at a meeting of the Society of Arts, of the condition of British industries in the eighteenth century. Perhaps no two periods in the history of social evolution, which followed one another closely, present greater contrast than the beginning of the eighteenth and the beginning of the nineteenth centuries. Indeed, so enormous was the change involved that Sir Henry Wood considers it rather as an "industrial revolution" than a stage in a process of evolution.

The invention of machinery, then the discovery of power to work that machinery, entirely altered the character of the industries of this country, and thus so modified the lives of its inhabitants that it is no wonder that social equilibrium is still far from being attained. Before entering into a very able discussion of the state of the various branches of industry up to the middle of the century, Sir Henry gives us a vivid description of the social conditions then prevailing with regard to the means of intercommunication, and the knowledge of scientific applications for doing the work of the industrial world.

He then begins with an account of the various branches of the textile and other trades, deeply interesting, not only to those desiring a knowledge of their history, but to all students of the economic position at that time. One curious fact impresses itself on the mind of the reader, that is, how greatly the development of trade was hindered by the very means used to encourage certain particular trades which were protected by Government action. There was certainly no *laissez-faire* in those days.

The most important and most ancient of British manufactures was the woollen industry. It was in a state of great prosperity in the eighteenth century, and was even down to 1770 a domestic industry carried out in the homes of the farmers, who produced the wool, and carded, spun, and wove it into cloth by the help of their families and servants. Nearly all farmers depended on this industry to enable them to pay their rent. For its protection enactments were passed to prevent the export of the raw material; laws were also passed to prevent the mixture of cotton and wool or of linen and wool in weaving fabrics. It was to prevent competition with this valuable trade that one of the Parliaments of that period killed the Irish woollen trade, particularly its blanket trade, by putting an import duty on its goods. Sir Henry Wood does not mention this fact, but he states that the encouragement given to the Irish linen industry was to prevent that country entering into competition with England. In the eighteenth century, as now, Ireland and Scotland seem to have been the chief manufacturers of linen.

Probably it was owing to these repressive regulations that England was one of the last countries to adopt the manufacture of cotton. The skill of her spinners was only equal to producing very coarse cotton yarns. Beautiful muslins and calicoes were imported from India, and became so popular that in 1760 it was made "penal for any woman to wear a dress made of India calico." The wearing of French cambrics was also penal. One of the most fascinating sections of this volume contains the description of the gradual growth of the cotton industry as machinery was invented and perfected.

The making of linen and afterwards of cotton thread was first initiated in the west of Scotland by a woman named Christian Shaw; it rose to be an important trade, even in the eighteenth century, and its products were largely imported to England for purposes of lace making, then chiefly carried on in Devonshire and Bucks.

At the beginning of the century under discussion the manufacture of iron was at a very low ebb. Carried out since Roman times by the use of charcoal derived from wood, it had almost declined entirely owing to the destruction of the woods, and consequent legislative restrictions. The author traces the gradual development of the use of coal for smelting, beginning about 1735, at Coalbrookdale, first of all.

At this same place the method of casting iron was discovered and practised. Sheffield and Birmingham were already making a reputation for metal goods, including pewter, which was much used as a substitute for pottery. Until well into the middle of the century England was mainly dependent on France and Holland for the commonest kinds of earthenware.

Sir Henry Wood tells us that this period, until some time after the middle of the century, was not a happy one for science or for scientific development, and we therefore find that industries dependent on scientific knowledge, such as the making of glass and fine pottery, of brewing and other chemical processes, were in a backward state.

Enough has been said to show what a wealth of material has been skilfully put together, and this book forms a most trustworthy source of information when coming from one who is in such a position as the secretary of the Royal Society of Arts.

SPECTROSCOPY.

The Spectroscope and its Work. By Prof. H. F. Newall, F.R.S. Pp. 163+viii Plates. (London: Society for Promoting Christian Knowledge, 1910.) Price 2s. 6d.

ALTHOUGH classed as a manual of elementary science, this little volume will be found to cover a very wide range of the phenomena of spectroscopy. The opening chapters are occupied with the first principles of the undulatory theory, Newton's classic experiments, and the description of a simple spectroscopic outfit. In chapters iv. and v. the reader is introduced to the various types of emission spectra shown by radiations from various sources, and to the characteristics of absorption, including the solar fraunhoferic and chromospheric spectra. Chapter vi. deals very lucidly with the theoretical principles to be considered in the design of spectroscopic equipment, showing the relation between angular and linear dispersion, purity and resolving power of various dispersive media, &c. Coming next to the application of the spectroscope to definite branches of research, it is shown how, by the aid of large instruments of special design, the spectra of the stars may be studied, revealing their variation in chemical constitution. This naturally leads to the systems of classification which have been proposed to deal with the complex groupings. In describing the fluted structure of the third-type stars, such as α Orionis, it would have been more correct to speak of the maxima of absorption being nearest to the violet instead of saying that the brighter ends were towards the red, as it is usual to regard the heads of flutings as taken for reference to the positions of flutings. It is also perhaps unfortunate for the student that so much space should be given to the old, incomplete, and now little used classifications, while the more comprehensive and natural systems put forward of recent years are discussed in a few lines. The idea suggested on p. 81 that the maxima of the star Mira (*o* Ceti) are of the nature of a conflagration is scarcely to be recommended, especially when dealing with beginners, as the practically unchanging character of the spectrum of the star (apart from brilliancy) even at maxima precludes the probability of any such chemical changes as must accompany the production of flame.

Chapter viii. is occupied with the method and progress of determining the motions of approach or recession of celestial bodies by Doppler's principle of changes of wave-length.

The great field of solar observation is very efficiently summarised in chapters ix., x., and xi., including the new results obtained by the use of the spectroheliograph (a simple diagram such as is often used would have been of value in rendering the explanation of this instrument much easier); the phenomena of the prominences and reversing layer during a total solar eclipse; the sun's rotation and that of the various planets. In chapter xi. particular attention is given to the spectra of terrestrial atmospheric phenomena by the detection of special features in the solar spectrum at different altitudes.

Chapter xii. is devoted to a short outline of the methods of investigating long wave radiations. The inductive method of presenting the reasoning is very acceptable, and the beginner who has mastered the subject so far will be well equipped for entering on the more advanced branches of this intricate section of spectroscopy.

The concluding three chapters deal with the physical sections of spectroscopy. The various systems of harmonic laws found so closely to represent certain types of spectra are well described. Perhaps in the presentation of the diagrams to illustrate these it would have been preferable to adopt the same scheme of orientation for the spectra. Thus in Fig. 46 the red end is to the right, with all the lines of the series converging to the left or violet; while in Fig. 47 the red end is towards the left, and although the series lines really converge to the violet as before, it is confusing for a beginner to have to find that things are all turned the opposite way. This is all the more important from the fact that there are series actually converging in opposite directions. The phenomena of diffraction and general use of gratings for producing spectra are next given, though necessarily condensed. In a manual avowedly written to induce readers to repeat the experiments, mention might well have been made of the fact that excellent replicas of original Rowland gratings, both plane and concave, are now readily obtainable at a moderate price, as it is not often that an original grating is available for general experimental purposes.

It will have been noticed that the description of the application of the spectroscope has been almost confined to its astronomical aspects; it should not be forgotten that spectroscopic analysis is at present playing an important part in the chemical and metallurgical industries.

Eight plates are given at the end of the book, showing various representative spectra. There is also a large coloured plate as frontispiece showing certain elemental and other spectra.

It will be evident from this summary that the book under review should serve as a most useful introduction to the study of spectrum analysis. It appropriately fills a position between the elementary primer with little or no technical information and the more formidable complete treatises which are admittedly repellent to the beginner.

THE THEORY OF METALLOGRAPHY.

Metallography. By Dr. Cecil H. Desch. Pp. x+429. (London: Longmans, Green and Co., 1910.) Price 9s.

DR. DESCH has evidently been at great pains to compile a work that shall give a fair idea of the subject as a whole as it appeals to him, and he is, above all, a theorist. It is a difficult work for the writer to review, for two reasons: because it covers practically the whole range of this enormous subject and is therefore necessarily dogmatic on many matters that, if disagreeing with the author, it would need much space to discuss adequately; and, secondly, because he dismisses the whole Sheffield School thus:—"This (the Osmond) hypothesis has been generally accepted as the best expression of the known facts, in spite of strong opposition from a (the Sheffield) school of metallurgists . . ." although on pp. 363 and 364 we find rather contradictory opinions, such as "β-iron was originally described by Osmond as a hard variety of iron. It is more correct to say that it is capable of forming solid solutions with carbon, which become hard under certain conditions of cooling."

The "eutectic-times" method for fixing the eutectic composition was used by Arnold in his "Influence of Carbon on Iron" (Proc., Inst. C.E., 1895–6, part i.), although Tammann is credited with its first use in 1903 (p. 18).

The author might with profit study "The Diffusion of Elements in Iron," by Arnold and McWilliam, I.S.I., 1899, No. 1, instead of the preliminary announcement of 1898, which he quotes, and besides further details on diffusion would find that these authors used the quenching method then, in an endeavour to judge of the condition of the carbon, &c., at high temperatures. Also in connection with the method of changing structure from that showing Widmanstätten figures to granular, the author credits the discovery to Fraenkel and Tammann in 1908, whereas the fundamentals of the matter were first published by Arnold and McWilliam in NATURE, November 10, 1904, p. 32.

A good account is given of the diagram of thermal equilibrium, and on p. 32 it is pointed out that the intermetallic compounds do not conform to our ideas of valency.

The sixth chapter is a good one on practical pyrometry and thermal analysis, but actual work on the subject, and recent discussions have surely at last made it plain, that the author is entirely mistaken in his statement on p. 126 that "In accurate work on the transformations of solids, however, one or other of the difference methods is almost invariably adopted." As recently as the Buxton meeting of the Iron and Steel Institute, September, 1910, it was distinctly shown that in a 0·2 per cent. carbon steel the best workers by the difference method do not divide the Ar_2 point, whilst those working with the present modifications of Osmond's inverse-rate method divided the A_2 point with ease, absolutely proving the superiority of the latter method.

Chapters vii. to xiii. deal with the preparation of micro-sections; crystallisation of metals and alloys;

under-cooling and the metastable state; diffusion in the solid state; physical properties of alloys; and electromotive force and corrosion. In chapter xiv. the construction of the equilibrium diagram is clearly explained, and the remainder of the book deals with the condition of metals in alloys, plastic deformation, the metallography of iron and steel, and the metallography of industrial alloys.

The present writer has made many notes on points in these chapters, as p. 222, "white cast-iron, martensite and cementite," instead of pearlite and cementite. The author is good on the difficult subject of hardness. P. 276, aluminium alloys have "a lower hysteresis than the purest specimens of iron . . . probably due to . . . removing oxygen." This is more likely to be due to the larger crystals formed, and the author, in such a theoretical work, might use the term "crystal" occasionally instead of "crystal grain."

In the chapter on the metallography of iron and steel there is so much that is erroneous that it is impossible to deal with it properly, but as an example the statement on p. 374 that "A tool steel containing 1·6 per cent. carbon, quenched from 800° C. in ice-water, consists of pure martensite," is meaningless.

The work is, however, one that every student of metallography should possess, for although there are so many points in it with which one does not agree, the author has given on the whole a fair account of theoretical matters connected with metallography, has scoured the literature of the subject, even extending to Russian, and has given copious references which must prove useful to those investigating the problems of metallography, who desire with a minimum expenditure of time to find out what has been done on their particular branch.

A. McWILLIAM.

PHYSIOLOGICAL CHEMISTRY.

Practical Physiological Chemistry. By Dr. R. H. Aders Plimmer. Pp. viii+270. (London: Longmans, Green and Co., 1910.) Price 6*s*. net.

THIS is really the second edition of Dr. Aders Plimmer's excellent manual. The first appearance of the book was privately printed for use in the practical classes of physiological chemistry at University College, London, but a good many copies were distributed to other teachers, and to the Press. A favourable notice of this preliminary edition appeared in the pages of NATURE at the time. The publication of the book for general sale is an indication of the way in which the teachers of the subject welcomed the new departure in the presentation of the subject. For it is a new departure; hitherto works on the subject have been written by physiologists; the present book is written by a chemist; it is physiological chemistry as opposed to chemical physiology.

The increasing exactitude of knowledge in the chemistry of those carbon compounds which are the constituents or products of living matter warrants the appearance of a book written to show that physiological chemistry is only a branch of organic chemistry, and Dr. Aders Plimmers has been successful in showing the connection of the two by the insertion of the appropriate and logical links which unite the introductory chapters on organic chemistry proper with its daughter science.

The main aim of the work is to make it a trustworthy practical guide, and no laboratory worker can afford to be without it. Its ideal is that every student shall work through all the exercises; these are set out with detail and in a clear manner, so that there is no reason why the student should fail to do so under his teachers, except that of time, and time is a very important factor for students of medicine, to whom the work is primarily addressed. In the medical curriculum, the number of subjects is growing every year, and each one of these is expanding and seeking to encroach more and more on the unfortunate student's already too-full day. Teachers are already seeking means to limit in particular certain preliminary subjects, and to exclude those portions which have but little direct bearing on his future practical life. There is no subject, however, which has such a direct bearing on medical practice as physiological chemistry; its relationships to pathology become clearer with every advance in knowledge; if there is one subject more than any other which should not be curtailed, that subject is physiological chemistry.

W. D. H.

SYSTEMATIC BOTANY.

Das Pflanzenreich. Regni vegetabilis conspectus. Edited by A. Engler. Vol. iv., pt. 104. *Papaveraceae-Hypecoideae* et *Papaveraceae-Papaveroideae*. By Friedrich Fedde. Pp. 430. (Leipzig: W. Engelmann, 1909.) Price 21.60 marks.

THIS volume forms the fortieth part of the great series of monographs in course of publication under Dr. Engler's editorship. It comprises the family Papaveraceæ as understood in the restricted sense, that is, without the Fumariaceæ; the account of these will be issued subsequently as Papaveraceæ-Fumarioideæ. The special portion of the work, the systematic treatment of genera and species, is preceded by a general account of the family occupying eighty-three pages, in which Dr. Fedde discusses the morphology and anatomy of the vegetative organs, with special reference to the value for systematic purposes of the anatomical characters; the position of the laticiferous vessels and the character of the latex is found most helpful in this respect. The floral structure and its modifications are discussed at considerable length, and also the fruit, especially the various mechanisms of dehiscence. There is also a useful section on geographical distribution, a discussion of the affinities of the family, and an account of its economic uses.

The great value of these monographs lies, however, in the systematic portion, which should represent the results of the work of an expert student of the family on all the available material. Dr. Fedde is known as an authority on the Papaveraceæ, and we look to his monograph for a careful and considered systematic presentation of the family. It is somewhat surprising therefore to note the treatment of the earlier genera of Papaveroideæ which, as Platystemon and Eschscholtzia, are confined to Pacific North America. In

Bentham and Hooker's "Genera Plantarum," these genera are credited with one and four to five species respectively, and while we might expect some increase in the number of known species since the date of issue of that volume, it is with somewhat of a shock that we find Platystemon credited with fifty-five and Eschscholtzia with 123 species. In Platystemon forty-nine of the species are of Greene and six of Fedde, in Eschscholtzia 104 of Greene and twelve of Fedde. Prof. E. L. Greene, we believe, holds views as to the origin of species which do not accord with those generally accepted, and these views are no doubt responsible for the description of species based on characters which might otherwise be regarded as representing mere variants of a single species. Dr. Fedde has not only adopted Dr. Greene's estimate, but added to the number. He perhaps shrank from the difficult task of reducing the species to more workable proportions, and took the path of least resistance. The result is, however, an increase in the number of those genera, which, like Cratægus in America, and Rubus in the Old World, have been rendered hopelessly unworkable by any but the most devoted expert. This method of treatment of some of the genera leads to a want of uniformity in the work as a whole. Thus under the common poppy, *Papaver rhoeas*, are twenty-six varieties and subvarieties, which probably have as good claim to specific distinction as the "species" of Platystemon.

In dealing with the genera of Chelidonieæ, Dr. Fedde has followed the limitation of species accepted by Dr. Prain, though he does not adopt his reduction of several of the genera, Dicranostigma, Hylomecon, and others, to subgeneric rank under Chelidonium. On the whole, however, Dr. Fedde shows a disinclination to differ from authority which we do not expect from the expert who has exhaustively surveyed the entire field of a large natural order. Thus under Meconopsis, while accepting Dr. Prain's sections, he suggests with regard to two of these, Aculeatæ and Primulinæ, that the division is not a natural one.

As regards the presentation of genera and species, the descriptions are full, the synonymy and geographical distribution are carefully worked out, and collections and numbers are largely cited. The index is a good one, but would be improved by the repetition of the genus name at the head of each column, thus avoiding the necessity for turning back to find the genus to which the species names belong.

A. B. R.

OUR BOOK SHELF.

Woodcraft for Scouts and Others. By O. Jones and M. Woodward. Pp. 156. (London: C. Arthur Pearson, Ltd., 1910.) Price 2*s*. net.

THAT the present generation of country people do not study woodcraft and field-lore with the zest and thoroughness of their forefathers, is a regrettable fact too well known to all capable of forming an opinion on the subject. The nature-knowledge of the old-fashioned shepherd has been replaced by a superficial education of a different class, which is of little or no use to its possessor, and the intimate knowledge of the creatures of the forest, field, and stream owned by the professional poachers of a generation ago has to a considerable extent vanished with the diminution in the numbers of that class in many districts. Nor is this all, for ordinary country lads, in some counties at any rate, show a lamentable lack of knowledge of the names of wild plants and birds as compared with their grandfathers. That the scout movement, if properly conducted will do something to improve this state of affairs in the case of the rising generation is almost certain, for it is obvious that to orient one's position in a wood at night, to follow the trail of a suspect, or to escape the attentions of an enemy is impossible without a full knowledge of woodcraft in its widest sense.

As an aid to knowledge of this nature, the excellent little volume by Messrs. Jones and Woodward is very opportune, if only it reaches the class for which it is primarily intended. Both authors appear to have a thorough grasp of their subject, and the amount of information contained in their work is little less than marvellous. In the tenth chapter there is perhaps a little too much tendency to convert the young scout into a rabbit poacher, and the expression on p. 136, "to break the law of trespass," is an indication that the authors are not so well versed in the common law of their own country as they might be. In treating of the animals and plants of the countryside, the authors are just as much at home as when discussing old-fashioned country remedies, or the difference between wholesome and noxious funguses, and their work as a whole leaves little or nothing to desire in the matter of completeness and thoroughness.

R. L.

A School Course of Heat. By R. H. Scarlett. Pp. xvi+300. (London: Longmans, Green and Co., 1910.) Price 3*s*. 6*d*.

THIS book is intended for the use of students who have already passed through an elementary course in general physics. The author devotes the first thirty pages of the present volume to a recapitulation of the elementary portions of heat. The rest of the book deals with the more advanced parts of the subject and touches briefly upon some points which do not usually find a place in a school text-book.

The subject is developed throughout along the line of practical work in the laboratory, but we do not think the laboratory experiments are always well chosen. In dealing with the errors of mercury thermometers on p. 18, the author states that mercury is not quite uniform in its expansion, and near 50° C. on the scale, there will be a constant error amounting to almost a degree. This error, of course, will depend upon the glass, but one-tenth of a degree is nearer the average correction necessary from this cause. The method employed on p. 62 to obtain the relation between the density of a liquid at different temperatures and its coefficient of expansion will present difficulty to an elementary student, and it is certainly not sufficiently accurate for all experiments as performed in the laboratory. Thus, in the example given on pp. 64, 65, there is an error of 3 per cent. in the calculated coefficient due to the use of this approximate formula.

Similarly, in the treatment of coefficient of absolute expansion on p. 70, it is not made clear to the reader which column length is involved in the denominator of the expression obtained. The wrong one is measured in the illustrative example, making a $1\frac{1}{2}$ per cent. error in the result. The hydrostatic method is a most unsuitable one to employ for the expansion coefficient of ether between 10° and 30°, as given on p. 66. On p. 191 we are told that the steam and hoarfrost lines intersect at 0° C. The chapter on thermal conductivity would have been improved by

the inclusion of some experiments within the range of possibility for the student. Forbes' method is entirely unsuitable for performance in a school laboratory.

Die praktischen Schulerarbeiten in der Physik. By Dr. W. Leick. Zweite Auflage. Pp. 49. (Leipzig: Quelle and Meyer, 1910.) Price 0.80 mark.

THIS pamphlet consists of two parts, of which the first and longer is a plea for the further introduction into German schools of laboratory work in practical physics, while the second gives a few selected examples of the kinds of work which the author regards as specially suited for schools. It appears that comparatively few of the German *Gymnasien* and *Realschulen* have as yet introduced practical physics into the school curriculum, although there is at the present time a vigorous movement in favour of its compulsory adoption in all higher schools. The author sets forth very clearly the advantages of individual practical work, and discusses at some length the objections that have been raised against laboratory work in schools.

It is interesting and refreshing to find a German author holding up English educational methods as a model for his countrymen. He is, however, severe on that method of teaching which induces the student, or professes to induce the student, on the strength of a few experiments (probably badly performed) to regard himself as the discoverer of natural laws. The examples in the second part of the pamphlet illustrate other and better methods of arousing the interest of the pupil, and show that Dr. Leick is a teacher who by his own originality will induce originality in his pupils. There is a fairly full bibliography.

H. E. S.

(1) *Who's Who*, 1911. Pp. xxvi+2246. (London: A. and C. Black.) Price 10*s*. net.
(2) *The Writers' and Artists' Year Book*. Pp. viii+132. (London: A. and C. Black.) Price 1*s*. net.
(3) *The Englishwoman's Year Book and Directory*, 1911. Edited by G. E. Mitton. Pp. xxxiv+386. (London: A. and C. Black). Price 2*s*. 6*d*. net.

THE new edition of "Who's Who" (1) shows another annual increase in size, containing eighty-four pages more than the last issue. Due prominence is given to the biographies of men of science, about whom the volume provides many interesting personal facts, as well as details of their professional careers. This work of reference is more than ever indispensable.

The "Writers' and Artists' Year Book" (2) is a very useful directory for writers, artists, and photographers. It gives just the information which these workers require. The new tables in the book include clubs for authors and artists, and there is an article this year on the law of copyright.

We agree with the editor of "The Englishwoman's Year Book" (3) that no woman who takes any part in public or social life can afford to be without this volume. The book is now for the first time divided into two parts: one including education, professions, and social life, and the other being mainly devoted to philanthropic effort. An especially valuable feature is the section giving particulars of scholarships offered to women by the different universities.

Notes on Physiology. By Dr. Henry Ashby. Eighth edition. Revised by Hugh T. Ashby. Pp. xxix+346. (London: Longmans, Green and Co., 1910.) Price 5*s*.

ALTHOUGH this little book has seen eight editions, and so has successfully catered for a certain class of students, that fact alone must not be taken as evidence that the book is a good one. There is little or no attempt made to keep pace with the advance of modern physiology. Old and incorrect statements are still retained, new work and new ideas are almost altogether omitted. The book may perchance still enable the lazy student to scrape through his examination on the minimum of pass marks, but it is only right to warn intending purchasers that to rely on Ashby's notes alone will be like leaning on a broken reed. A catalogue of the various faults, both of commission and omission, which adorn nearly every page, might be given, but it would be hardly fair to the readers of NATURE to use its columns in this way. These might more suitably appear in periodicals which are more widely read by the medical students for whom this book is intended.

W. D. H.

The Stars from Year to Year, with Charts for Every Month. By H. Periam Hawkins. Pp. 23. Price 1*s*. net.
The Star Calendar for 1911. By H. P. H. Price 1*s*. net.
The Star Almanac for 1911. By H. Periam Hawkins. (Bedford and London: *Beds. Times* Publishing Co., Ltd.; and London: Simpkin, Marshall and Co., Ltd., 1910.) Price 6*d*. net.

ONCE more we welcome the three annuals prepared by Mrs. H. Periam Hawkins as being among the most useful, low-priced aids to amateur astronomers. "The Stars from Year to Year" is practically the same as last year, and in some respects this is to be regretted. For example, turning to "Halley's Comet," we find the latest information is the statement that "according to the latest computations of Messrs. Cowell and Crommelin it will be nearest the sun on April 30, 1910." It seems a pity that in a book, apparently issued for 1911, some short *résumé* of the facts we learned from the re-apparition of so famous an object is not given.

In the "Star Calendar" the date calendar and the four quotations have been changed, and we would suggest that in future issues the fastening at the centre of the planisphere should be strengthened. The addition of the equator and ecliptic, especially the latter, might also prove useful.

No handier almanac than the broadsheet prepared by Mrs. Hawkins can be hung in the sanctum or observatory of the amateur. Eclipses, meteor showers, the positions of the planets, &c., are tabulated, and reproductions of the lunar eclipse of April 30, 1905, and Ritchey's Orion nebula are also given.

W. E. R.

The Medical Directory. 1911. Pp. 2168. (London: J. and A. Churchill.) Price 14*s*. net.

IN addition to full information of the professional qualifications of recognised practitioners, this very complete directory contains all the facts a medical man is likely to expect in such a work of reference. Among the new features of the sixty-seventh issue may be mentioned new lists of coroners and Continental health resorts; a summary of the law as to cremations; information as to motor-car and petrol rebates; and a numerical summary showing the geographical distribution of the medical profession.

Philips' Nature Calendar, 1911. (London: G. Philip and Son, Ltd.) Price 6*d*. net.

NOTES are given on the characteristic animal and plant life of each month, and on garden operations. There are also notes on general aspects and problems of nature-study, intended to suggest subjects for lessons and observations. The calendar is intended to be hung upon a wall, and it should be of decided service in directing attention to the changing face of animate nature throughout the year.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Observations of Mars.

IN NATURE of November 10, 1910, Mr. J. H. Worthington gives his interesting observations of the fine straight lines which he saw on Mars at Flagstaff, and expresses his belief that these "telegraph wires" are objective realities in the focal image. Although I have not seen Mr. Worthington's paper, yet I shall reply to it, basing myself on the accuracy of the abstract given of it in the Journal of the British Astronomical Association, vol. xxi., p. 130.

Now Mr. Worthington's very brief experience of the appearance of Mars during the few days spent at the Lowell Observatory is necessarily outweighed by that of an astronomer like Prof. A. E. Douglass, who spent several years in the planet's study at Flagstaff. But what was the conclusion of Prof. Douglass from his observations of the straight "canals," of which he saw more than anyone else? That they are optical "illusions" having "worked serious injury to our observations" (*Popular Science Monthly*, vol. lxx., May, 1907). It would be difficult to conceive a more decisive symptom of frailty in the "canal" question than this surrender to truth of its ablest exponent.

In discussing my work rather than the collective evidence of great telescopes (of which my results form an integral part), Mr. Worthington seems to show some misapprehension in the very object of his criticism, for my conclusions are identical with those arrived at at Lick, Yerkes, and Mount Wilson. Thus, in 1895, Prof. Barnard, summarising his evidence with the 36-inch at Mount Hamilton, said:—"No straight, hard, sharp lines were seen on the continents, such as have been shown in the average drawings of recent years" (Monthly Notices, R.A.S., vol. lvi., January, 1896, p. 166). On September 21, 1909, I state that "those geometrical spider's webs . . . do not exist" (Journal of the British Astronomical Association, vol. xx., p. 141). A fortnight later Prof. Frost telegraphs:—"Yerkes telescope too powerful for canals." Lastly, on January 3, 1910, Prof. Hale proclaims "the perfectly 'natural' appearance of the planet" in the 60-inch reflector, by far the most perfect and powerful instrument ever made, "and the total absence of straight lines" (Journal of the British Astronomical Association, vol. xx., p. 192).

It would thus appear that Mr. Worthington is perhaps attempting to revive the old controversy on the relative merits of large and small telescopes. But that question has been settled long ago, so that any attempt to renew it can no longer deserve serious consideration. The overwhelming superiority of large instruments has been often demonstrated on double stars, for the two discs seen in a great aperture will be blended, by increased diffraction, into a single mass of light with an 18-inch; and, as the smaller star is observed to revolve in perfect harmony with Newton's law, there can be no doubt whatever as to its objective existence. The same fundamental principle holds good for planetary detail. Two contiguous, irregular, bright spots on Mars in a 33-inch will appear as a single round spot in an 18-inch. Hence delicate objective markings, which are quite plain in large glasses, cannot be defined at all with inadequate instruments, and this well-known rigid demonstration establishes for ever the hopeless inferiority of small telescopes.

The advantage of great objectives I have further shown on Mars when stating (December 23, 1909) that the geometrical network vanished in perihelic opposition of the planet, while much more delicate detail was quite plain (Journal of the British Astronomical Society, vol. xx., p. 141). On September 20, 1909, under perfect seeing, I can discover no straight lines, but draw Lacus Mœris as a vast shading, and Deltoton Sinus triple (letter to Schiaparelli, dated September 21, 1909). A fortnight later the same region of Mars is photographed at Mount Wilson, and Lacus Mœris comes out likewise as a vast shading, while the triple structure of Deltoton Sinus is also confirmed. On November 3, 1909, at Flagstaff, the "lake" is missed (although covering fully one-sixth of the diameter of the planet), and Deltoton Sinus appears single, while a host of lines furrow the surface (Journal of the British Astronomical Association, vol. xx., pp. 376–7). But the fact that straight lines are drawn when more delicate detail, confirmed by photography, is missed, constitutes another proof, not only of the inadequacy of the 18-inch as compared with the 33-inch, but also of the inanity of the "telegraph wires."

Yet my position in the "canal" question should not be misunderstood. If by "canals" be meant straight lines, then I think the "canals" do not exist; if we mean irregular, more or less streaky markings, then the "canals" exist. Of course, it would be utterly illegitimate to speak of genuine canals on Mars. But in the positions of Schiaparelli's lines I often saw, with the large telescope, either (*a*) complex, irregular, knotted, or winding bands; or (*b*) jagged, isolated, dark spots; or (*c*) indented edges of differential shadings. Under good seeing, the irregularities of these objects were held steadily from five seconds to several minutes. From my experience of the "canals" since 1894, with various apertures, I am led to account for the single and double straight of lines of Schiaparelli as follows: over the objective substratum of irregular, sinuous corrugations diversifying the Martian surface, a tired eye will discover by flashes a geometrical appearance. Impressions of single lines will fleet now and then either over a narrow objective streak or over the jagged border of a half-tone, while double parallel lines will flash in the position of a broader band. But, as pointed out by Mr. Maunder, the straight lines (which, so far as my evidence goes, are usually glimpsed severally, and not collectively) are merely optical summations of groups of minute irregularities beyond the reach of the instrument used. Prof. Lowell may justly feel proud upon having succeeded where all his predecessors failed, and upon having photographed the irregular streaks of Mars by ingenious methods, devised at his observatory.

A new notion was recently introduced in science by the "born-good" and "born-bad" air of some localities; but the splendid results of Dawes, Lockyer, Burton, Green, Denning, and others in the British Isles (a country most unfavourable to telescopic work), prove that the difference between the best and worst observing stations is largely a difference of duration of good seeing. Transparency of air, which is indispensable in detecting faint stars or nebulæ, seems to be of little moment in planetary detail. When minute Martian irregularities, beyond the reach of an 18-inch at Flagstaff, are held steadily near Paris with a 33-inch; when such detail is corroborated by the unanswerable testimony of photography; and when the blue cap of Saturn is a most conspicuous feature at Meudon a whole year before the recent Solar Congress, we are bound to admit that *any* point on the earth's surface may give us short spells of perfect seeing.

E. M. ANTONIADI.

Paris, December 28, 1910.

Sir Ray Lankester's Book on the Okapi.

SIR HARRY JOHNSTON is wrong in suggesting (NATURE, December 15) that the incompleteness of my monograph of the okapi is due to the "financial control" (presumably he means the trustees of the British Museum) disliking the expense of publishing a volume of text. The full expenditure required was approved by the trustees when I was director of the museum. The absence of any further text than that which accompanies the plates and figures in the volume, as issued, is solely due to the fact that I have not provided such further text.

It would have been better to call the book "Contributions to a Knowledge of the Okapi" rather than a "monograph" of that animal, since although it is in the strict sense a monograph, it does not profess to give (as Sir Harry Johnston seems to think that word implies) a *résumé* of all that is known and has been written on

the subject. When my book was originally planned it was intended that it should be a monograph of the specimens of okapi contained in the national collection, and it thus became entered on our list as "the monograph on okapi."

More, no doubt, might be written about the specimens which I had under examination, and I should have, in some circumstances, been able to add to what the book contains; but the problems which arose in the course of my work could not, in many cases, be satisfactorily solved by the examination of the existing material.

We shall have to wait for new observations made upon fresh or living specimens for a solution of the question as to what are the characteristics of the male and female okapi respectively, what are their geographical variations, and whether there are distinct races or subspecies.

E. RAY LANKESTER.

29 Thurloe Place, South Kensington.

SIR E. RAY LANKESTER is correct in supposing that I was misled by the last paragraph of the preface to his work on the okapi into the belief that there had been or might be an additional volume of text to supplement the illustrations given in the volume under review. From private correspondence which passed between Sir E. Ray Lankester and myself about three years ago I was under the impression that the "text" alluded to was in existence, and perhaps I arrived too hastily at the conclusion that for reasons of economy it had been put aside because of the intervening publication of M. Jules Fraipont's work. The title "Monograph of the Okapi" to which Sir E. Ray Lankester refers as likely to mislead an appraiser of his work was not of my bestowal, but is the official title of this valuable and admirably produced volume. The illustrations are fully described; but I suppose what I missed, and what I hoped might still be forthcoming, were the deductions to be drawn from these illustrations as to the affinities and systematic position of Okapia: in short, a statement of Sir E. Ray Lankester's personal opinions. He is probably quite right to withhold these until something is known of the beast's musculature and intestines.

H. H. JOHNSTON.

The Dynamics of a Golf Ball.

WITH a view to reproduction in the forthcoming Life of the late Prof. Tait, I have just been editing his popular article on long driving, which appeared in the *Badminton Magazine* of March, 1896. On reading Sir J. J. Thomson's lecture, as published in NATURE of December 22, 1910, I was greatly struck with the strong resemblance between golf-ball paths worked out mathematically by Tait and the stream lines of the electrified particles in the ingenious experiment devised by Sir J. J. Thomson. A few of Tait's calculated curves were given in NATURE, vol. xlviii. (June 29, 1893); but better examples will be found in the second paper on the path of a rotating spherical projectile (Trans. R.S.E., vol. xxxix., or Scientific Papers, vol. ii., p. 386) and in the article on long driving already mentioned.

By laborious arithmetical calculations, Tait and his assistant computer worked out a series of possible trajectories with various values for the transverse force due to the underspin, obtaining, among others, the kinked path which Tait had already demonstrated by undercutting a light rubber balloon. It is extremely interesting to see how the several types of curve figured by Tait for the same initial speed of projection, but varying degrees of underspin, are almost accurately reproduced by Sir J. J. Thomson's beautiful method of subjecting a stream of negatively charged particles to a suitable combination of electric and magnetic forces.

C. G. KNOTT.

Edinburgh University, January 2.

On the Simultaneity of Abruptly-beginning Magnetic Storms.

I WAS naturally much interested in Dr. Krogness's communication to NATURE of December 8, 1910 (p. 170), and wish to take this occasion to express my gratefulness to him for making known his criticisms on some of the results of my investigations on magnetic storms, as well as on those of Mr. Faris, where there is opportunity for reply. I am also glad that he has made his statements sufficiently direct, so as to admit of an equally direct answer.

Dr. Krogness first wishes to show that my conclusion, that even the sudden magnetic disturbances do not begin strictly at the same instant, but at measurably different times at various points on the earth, rests on insecure foundation; he would make it appear that it was based on but two cases, viz. the disturbance of May 8, 1902, and that of January 26, 1903. He will find a table (No. VIII.) in No. 2 of my researches (December, 1910, issue of *Terrestrial Magnetism and Atmospheric Electricity*) which summarises the data from thirty-eight abruptly-beginning disturbances between the years 1882 and 1909, thirty-four of which were available to me when the article was prepared which Dr. Krogness reviews (*loc. cit.*, pp. 19–20).

The table gives the date and approximate Greenwich mean civil time for each of these thirty-eight disturbances, next the number of observatories for which time data were available and the approximate portion of a complete circuit of the earth embraced by the contributing observatories. Then the value of x, or the time in minutes required by a disturbance to pass over one-fourth of a great circle, and in the following columns is given the approximate weight to be attached to any particular value of x, as determined from all circumstances involved, and the source from which the data have been obtained. A plus sign attached to x means that the disturbance progressed apparently in an eastwardly direction, as indicated by an increase in the Greenwich mean time of beginning at easterly stations over that at westerly ones. A minus value of x means, of course, the reverse. Nos. 35–38 were since added on the basis of data communicated by Mr. Faris (*loc. cit.*, pp. 213, 214).

Out of thirty-eight values of x, only ten, or about one-fourth, have the negative sign, so that three-fourths of the disturbances of the type here considered show an eastward progression at the times of beginning. In view of the greatly varying circumstances on which the figures are based—different observatories, different instruments, times scaled by different persons, different years, covering a period of two and a half times that of a sun-spot cycle—it is going to be difficult to explain the persistency of the plus sign by any such possible errors as Dr. Krogness points out, which, as a matter of fact, even he will hardly contend would be always in the same direction for *every* observatory, nor even necessarily always the same at the same station.

From this table the following results are derived:—

Weighted mean value of 28 plus values of x = $+1 \cdot 65$ minutes
,, ,, 10 negative ,, = $-1 \cdot 80$,,
Weighted mean without regard to sign ... = $\pm 1 \cdot 69$,,
(Hence velocity of progression for average sudden disturbance, whether to the east or to the west, is ... ... 99 km./sec.)
Weighted mean with regard to sign ... ... = $+0 \cdot 74$ minute
(Hence average *algebraic* velocity of eastwardly progression is ... ... 225 km./sec.)

We thus get a velocity for the progression of a sudden disturbance on the order of 100 to 200 kilometres per second; hence, if a sudden disturbance passed around the earth completely it would take approximately between seven and three minutes. We are here, then, dealing apparently with a velocity of a greatly subordinate order (1/3000 to 1/1500) to that of electromagnetic waves, which would require but a tenth of a second to pass round the earth, and of kathode rays which would take on the order of a half-second.

Another line of argument set forth in my papers is based on the harmonic analysis of the typical disturbance here under consideration, for which the effect, in general, is an increase in H (horizontal intensity) over the whole earth and a decrease in Z (vertical intensity) in the northern magnetic hemisphere and an increase in Z in the southern. It was found, for example, that the disturbance system of

May 8, 1902, was a two-fold one: first, the stronger, a set of electric currents which, if negative, circulate in the upper regions around the earth eastwardly (anti-clockwise) if one were looking down on the North Pole, and secondly, a weaker system, imbedded within the earth, possessing the characteristics of directly induced magnetism. It is a matter of interest that the harmonic analysis prescribes the same direction of progression around the earth for the upper negative electric currents as has been revealed by the generally eastwardly progression of the times of beginning; and it is natural, then, to inquire whether these overhead negative currents consist of negative ions moving at the rate of 100 to 200 kilometres per second, the resulting effect of which on our magnetic needles is merely an exhibition of the Rowland effect on a scale far transcending any laboratory experiment.

We have found that the speed of these negative charges must be on the order of about 1/500 that of kathode rays. My provisional calculation showed that if we are dealing here with moving ionic charges, then at the height of about 75 kilometres the rarefaction of the air and the other necessary conditions, so far as can be judged from surface experiments, would be such as give a velocity of the order required to satisfy the apparently slow propagation of magnetic effects over the earth. The lower the current gets down the slower the speed, and, if other things are equal, the greater the effect. Whether this is in accordance with actual observation is at present undergoing an examination.

Now let us look briefly at the matter in another way. Suppose a negative ion is set in motion at a given altitude and in an easterly direction; the deflecting effect of the earth's magnetic field on the eastwardly moving negative charge is to bring it down closer to the earth. But, as we have seen, the ionic velocity decreases with decrease of altitude, and hence the magnetic effect produced by the moving charge on a needle at the surface would begin later and later as the charge travelled eastward. If, on the other hand, the negative charge started westward around our planet, then the deflecting effect of the earth's magnetic field would be to make the charge move higher and higher or faster and faster. We might thus possibly have the following state of things: due to some cause, electric charges are set in motion in every direction from a given point overhead. Those with an easterly component of motion would have their velocities checked in the manner just described, whereas those having a westerly component would have them increased, so that for two stations, one east and one west, the magnetic effect might be recorded later at the east station than at the west one—as we have actually found to have been the case in the vast majority of the thirty-eight cases above treated.

Dr. Krogness next attempts to break down the testimony regarding non-simultaneity of commencements of sudden storms furnished by Mr. Faris (*loc. cit.*, pp. 93–105). Dr. Krogness notwithstanding, Mr. Faris *does* make a statement (p. 98) as to his method of time scalings and the various matters involved to secure the desired accuracy. It is the custom in the Coast and Geodetic Survey to take into account every possible source of error, and as the result Mr. Faris says:—"It would thus appear that with especial care the times could be scaled from the magnetic records within one-half minute in any individual case."[1] He furthermore states (p. 105):—"In closing, it seems proper to state that the scaling of the times of the beginnings of sudden impulses is not so difficult a matter as it is to ascertain the exact correspondences in the curves at different stations, for the form of the photographic record of the starting impulse is not always exactly the same at different places; that is to say, the fixing of the exact point of the beginning of the disturbance is sometimes more difficult than the reading of the time after the point is decided upon. This difficulty arises chiefly from the fact that the magnetic traces, except in tropical latitudes, are much of the time not smooth curves."

[1] In the December, 1910, issue (*loc. cit.*) Mr. Faris has two communications which will give further evidence on the matter of accuracy of his time scalings to which Dr. Krogness may be referred.

This matter of being sure of having precisely the same perturbation for all stations is one apparently insufficiently considered by Dr. Krogness. For example, he questions our time of beginning in the H disturbance for the storm of May 8, 1902, as recorded at Potsdam. I gave 12h. om., and he gets 11h. 58m.; I have had our scalings gone over once more, and have this to say: unless the Potsdam Observatory has revised the data furnished us (copy of magnetogram and accompanying time data), the time given by Dr. Krogness is wrong, and 12h. om. is correct. If our Potsdam data are correct, then Dr. Krogness has either made an error somewhere, *e.g.* may not have considered the fact that the middle of the hour breaks in the Potsdam curves is for local mean time, not for middle European time, or he has taken a small preliminary tremor observed at some of the stations, but of a different character than the particular perturbation considered. He should also remember we had before us the curves of twenty-five observatories, with the aid of which the identical characteristic point could be determined upon for each, so far as that is possible.

Another fundamental fact in terrestrial magnetism of which Dr. Krogness is not aware is this: the existence or non-existence of a terrestrial magnetic phenomenon cannot be proved by *one* magnetic observatory, no matter how excellent and superior its equipment may be—not even the whole European group, consisting of about twenty magnetic observatories, would in certain instances suffice. Since the publication of the papers criticised by Dr. Krogness, a prediction which I made has been found true. On p. 25, *loc. cit.*, I say:—

"In fact, I confidently expect, as soon as a complete analysis has been made of magnetic disturbances covering the greater portion of the earth, it will be found that the disturbance field, in general, presents all the same characteristics of the terrestrial, primary one—the disturbances will themselves reveal effects from terrestrial, continental, regional, and even local causes (earth currents, for example, whose path and intensity depend upon local character of soil, &c.)."

Mr. Faris has brought together for the March, 1911, issue (*loc. cit.*), the data from observatories all over the globe with respect to some peculiar magnetic disturbances which occurred between December 29 and 31, 1908. With his permission I will anticipate by saying that these disturbances, of which there were eight cases, occurred each time over restricted regions of the globe—*e.g.* in the United States and not in Europe, or *vice versa*, &c. The interval between the occurrence of the disturbance in the United States and Asia, or Asia and Europe, was not a matter of a few minutes, but a matter of many hours! Though this disturbance—whenever it occurred—never lasted much more than half an hour, and was during an otherwise magnetically calm day, nevertheless a number of observatory directors are on record as having recognised it and having characterised the day as disturbed (class 1). The interesting point is, however, that they did not all get it at the same absolute time, but at times differing by many hours! A discussion will be given in the March issue (*loc. cit.*).

Hence, by attempting to disprove a fact based on such extensive data as referred to above, with the aid of data at *one* observatory—Potsdam—Dr. Krogness has simply shown that he is unfamiliar with a fundamental fact regarding the *distribution* of magnetic phenomena. Every magnetic phenomenon known to me partakes of a most complex character, and to get a general result of value it is necessary to base an investigation, not simply upon one station or one part of the earth, but on as great a portion of the earth as possible—the greater the better.

Dr. Krogness next reverts to the disturbance of January 26, 1903, the times for which were scaled by Prof. Birkeland. He exhibits a rather interesting method of discrimination between the various stations, and appears to have overlooked where his own figures lead. He rejects *in toto* the three Coast and Geodetic Survey magnetic observatories, Honolulu, Baldwin, and Cheltenham—the latter two probably because Prof. Birkeland had found the identification of the point of beginning of the disturbance

difficult. But this Prof. Birkeland says was likewise true of Toronto, yet Dr. Krogness retains this station; why he rejects Honolulu Dr. Krogness does not say. Again, he overlooks the fact that when he corrects Birkeland's scaling for San Fernando he has improved the easterly progression—Prof. Birkeland's value was nearly two minutes too high. In view of the uncertainties in Prof. Birkeland's scalings revealed by Dr. Krogness, and as Prof. Birkeland fails to specify the particular element considered, not full weight could be attached to this disturbance in the above table. It should also be stated here that Prof. Birkeland considered, in all, six characteristic points of the disturbance curve, and my result was based on *all* the scalings—seventy-two in number—and not merely the half-dozen taken by Dr. Krogness. Did I myself consider such limited data as Dr. Krogness uses adequate for the purpose, I might point out that his own figures show an easterly progression of the times on the order of what is to be expected, which would have been still further accentuated had he not rejected Honolulu.

Just as I am preparing this reply, I am in receipt of a letter from Dr. Chree, dated December 6, 1910, accompanying a copy of the proof-sheets, which he kindly let me see, of his paper before the Physical Society, November 11; he had also given a paper on the same subject at the British Association meeting. He is not in agreement with my general deductions or with those of Mr. Faris. His criticisms are in part covered by the foregoing reply to Dr. Krogness, and in part by my article in the December (1910) issue (*loc. cit.*). I can only say here that I cannot agree with Dr. Chree in several of his own deductions, and especially with regard to the possible inaccuracy of Mr. Faris's time scalings: I beg to refer him to pp. 213–4 (*loc. cit.*). Nor can I enter here into a discussion with regard to his criticisms of my hypothesis of ionic currents, for it would seem that he has unintentionally put into his discussion ideas which are new to me. I will only remark that nowhere in my papers have I supposed such a simple overhead electric current in the plane of the geographical equator as postulated by him; this is best shown by my mathematical analysis.

In conclusion, I would like to state my position once more, viz. *even our most sudden magnetic storms begin at measurably different times for various stations distributed over the globe. The data thus far available would show that the Greenwich mean times of beginning increase more often in an eastward direction than in a westward one.*

Our explanations as to the cause may differ, but I believe what I have just stated to be an actual fact.

L. A. BAUER.

Washington, D.C.,
December 19, 1910.

Tribo Luminescence of Uranium.

MOISSAN first directed attention to the pyrophoric properties of metallic uranium. The luminosity shown on shaking a bottle containing metallic uranium is due to the oxidation of small particles of the metal. Uranium is a hard but brittle metal; when pieces of it rub together small particles are knocked off, and if these are neither too small nor too large the friction may be sufficient to heat them above 170° C., at which temperature uranium inflames in air. The presence of smaller particles, which do not inflame visibly in air, is shown by their incandescence in a gas flame lit by the "spark" from the metal. The luminosity obtained by rubbing metallic uranium is not the same class of phenomenon as the luminescence produced by shaking a tube containing uranium nitrate; the latter has been described as tribo luminescence (Wiedemann). If the tube containing metallic uranium is filled with hydrogen no luminosity is obtained, whereas the luminescence of the uranium nitrate is unabated in such an atmosphere. The sparks obtained from uranium are hot enough to kindle a gas flame or explode a mixture of hydrogen and oxygen; in fact, I have been able to work a petrol engine by igniting the gas charger by means of such sparks. The luminescence of the uranium nitrate crystals, on the other hand, is unaccompanied by any considerable rise in temperature. Pyrophoric properties similar to uranium are shown to a remarkable extent by Welsbach's alloys of rare earth metals and iron.

Tribo luminescence is shown by a large number of organic and inorganic compounds, *e.g.* arsenic trioxide, uranium nitrate, potassium sulphate, zinc sulphide, quinine valerate, aniline hydrochloride, benzoyl β-naphthylamine. Crystallo luminescence, or the luminosity produced during crystallisation, is practically the same phenomenon, being caused by the fracture of crystals after formation; it is well shown by mixtures of sodium and potassium sulphate. Tschugaeff found a connection between the optical activity and the tribo luminescence of organic substances, but Gernez has disputed the existence of any relation between them. Substances that phosphoresce readily under X-rays generally show tribo luminescence, and the connection between the two phenomena is accentuated by the observations of Karl, which show that quite pure inorganic substances do not show tribo luminescence. It is remarkable in view of the radio-activity of uranium that salts of this metal should show phosphorescence and tribo luminescence to such a degree; Karl has found, though, that quite "pure" uranyl acetate does not show tribo luminescence, while Tschugaeff mentions that the chloride and sulphate also do not exhibit this property, though they are all phosphorescent. The tribo luminescence of crystals may be likened—though analogies are dangerous guides to theories—to the bursting of an elastic band with a snap; when the cohesive forces between the molecules of the crystal are overcome the electrons are disturbed, and light waves result, while substances which easily phosphoresce or are radio-active would the more readily have their electrons disturbed.

Mr. Rudge mentions that the yellow oxide of uranium shows slight tribo luminescence; I could only obtain the effect by fairly vigorous rubbing in a mortar, and as the oxide changes to a dark colour with this treatment, the luminosity may be due to oxidation.

Mr. Rudge's letter directs attention to two interesting but distinct phenomena.

ALFRED C. G. EGERTON.

R.M.A., Woolwich.

The Clarification of Liquids by the Process of Tanking.

I SHALL be glad if any of your readers can give me information upon the following problem. In the clarification of liquids by the process of tanking, the settled clear liquid is drawn off from a tap situated on the side of the tank above the muddy layer. When the tap is turned on, does only the liquid above the tap run out or does some of the liquid below the tap run out also? In the special case of tanking oils, there is very little difference in specific gravity between the upper clear layer and the lower muddy layer. Further, how should the outlet be fitted so that on running out the upper layer the lower should remain least disturbed?

ROWLAND A. EARP.

Preston Brook, near Warrington,
December 22, 1910.

The Conduct and Song of Birds.

THIS morning, Thursday, is clear and frosty, but until now we have had constant rain. In spite of this the birds, for three or four days, have been singing as in early spring. The rooks have been visiting their old nests in the elms, and, our gardener assures me positively, have been carrying sticks and repairing their nests; this he has seen himself, and marked as exceptional. I suspect that this (unusual?) conduct and song herald a period of fine dry weather.

F. C. CONSTABLE.

Wick Court, near Bristol,
December 22, 1910.

P.S.—Fine weather here since December 22 until to-day, January 2!

THE NEW HAMBURG OBSERVATORY.

IN the United States the science of astronomy has enjoyed for many years the advantage of liberal financial support, and the erection of a new observatory on an imposing scale is no very uncommon occurrence. In Europe it is otherwise, and the establishment of a new observatory is a notable event. We welcome it as such, and watch its development with special interest.

The old observatory at Hamburg was founded in the year 1825. Its first director was C. Rümker, and the excellence of his services may be judged from the fact that the present staff is engaged upon a re-reduction of the catalogue which he formed. In 1906 it was decided to remove the observatory to a distance from the town, and the necessary funds were voted by the municipality for its equipment. The new site is at Bergedorf, about twelve miles south-east of the old observatory, and about 130 feet above the level of the Elbe. Work on the new institution has proceeded with great energy, and the observatory "Jahresbericht" for the year 1909 shows that the constructional part was practically complete at the end of that year. The report contains an excellent series of photographs of the several buildings in different stages of construction, and gives a good idea of what the observatory will be when it is in full working order.

The great feature in the plan of the new observatory is the complete isolation of the different instruments. Each has its own building, as shown in the illustration here reproduced. This is a principle to which we have long been tending, and here it is carried out with absolute and logical completeness. We are only too familiar with the old style of observatory building. Apart from separate structures, which are additions of a later date, it was usual to crowd the whole equipment—at least two equatorials, for instance, and a meridian circle—into one main building. The same building contained, under the same roof, the working rooms of the astronomers, and often—most objectionable feature of all—the residence of the director, and perhaps of an assistant as well. The new Hamburg Observatory carries modern ideas to their logical conclusion. The isolation of the instruments reduces mutual obstruction to a minimum, makes it possible to design each building solely to the advantage of the instrument it contains, and to a great extent removes the risk of fire, an ever-present danger in climates drier than our own.

The old-fashioned astronomer would expect a serious disadvantage in the weakening of central control. But this defect is avoided by a complete system of telephonic communication between the several buildings. The central offices of the observatory contain in a cellar six standard clocks. These are connected with a switchboard on one wall of a room in the basement. Close by is a chronograph by means of which all the clocks can be compared *inter se* and with all the observing clocks of the establishment. The Hamburg observatory is responsible for an elaborate public time service. The necessary electrical arrangements for this are placed on another wall of the same basement room. It is very natural that the installation of this complicated system of wiring has occupied much time, the underground cables alone running to a total length of about 1400 yards. When to the low-voltage system required for the telephones and time service is added the provision for distributing electric light and power, it can be judged to what extent the efficiency of a modern observatory depends on the technical application of electricity. Modern advances in astronomy are often attributed to the spectroscope and the photographic plate. This rather overlooks the help derived from electrical power,

FIG. 1.—The New Hamburg Observatory at Bergedorf: View from the South.

which has rendered the use of large-scale apparatus practically possible.

The new observatory will be powerfully equipped. The 10-inch Repsold-Merz equatorial has been moved from Hamburg, and is in working order. A 4-inch Repsold transit instrument remains for the present at Hamburg, and will be moved when the new institution is in a position to take over the time service. This will be the case when the installation of a new Repsold $7\frac{1}{2}$-inch meridian circle is complete. The mounting of this fine instrument will embody the ideas of Sir David Gill. The roof is of iron and in the shape of a half-cylinder, the shutters rolling apart over the east and west ends. The whole is protected from the direct radiation of the sun by a louvred wooden covering. Special arrangements are made to control the instrumental errors. To the south is an adjustable horizontal collimator of the ordinary type; to the north is a lens focussed on the *mire*, which takes the form of a vertical collimator, as at the Cape Observatory. Still further to the north, on the same meridian, will be placed the 4-inch transit instrument, which will use the same *mire*. The two instruments are thus in line, and an independent check is possible by comparing them directly.

In addition, the observatory will possess a large refractor of 24-inch aperture, a reflector of 40-inch aperture and 10-feet focal length, and a photographic combination. The mounting of the refractor will be by Repsold, and the lens by Steinheil; some delay has been caused by the difficulty in obtaining the discs of suitable quality. The large mirror has been made by Zeiss. For the photographic combination the observatory is indebted to Herr Lippert. It will comprise a telescope of the normal astrographic type, and two short-focus photographic objectives of 12-inch aperture. This work has also been assigned to Zeiss.

Dr. R. Schorr, the director, has expressed some disappointment at delays, particularly in completing the optical work. But in an undertaking of this magnitude something of the kind is inevitable, and we can only express admiration of the lines on which Dr. Schorr has designed the new institution, and the energy which is apparent in the progress already made.

H. C. P.

Lippert Astrograph. Meridian Circle. Reflector. Mire. Refractor. Transit Instrument.

FIG. 2.—The Main Buildings of the New Hamburg Observatory.

THE ANCIENT INHABITANTS OF THE NILE VALLEY.[1]

SOME ten years ago, when Lord Cromer was building up a medical school in Cairo, the task of establishing the department of anatomy was entrusted to a junior fellow of St. John's College, Cambridge, Dr. Elliot Smith. The young professor reached Egypt at an interesting phase of the development of our knowledge of the ancient inhabitants of that country. It was then becoming clearly recognised, thanks to the labours of Prof. Flinders Petrie and those associated with him, that certain of the burials were older than the dynasties, and that it had become possible to study the Egyptians of a prehistoric or predynastic period.

With the human remains of this ancient period Prof. Elliot Smith was soon brought in contact; in 1901 he had the good fortune to examine the bodies excavated by the Hearst Egyptian exploration of the University of California from a predynastic cemetery at Noga-ed-Deir, in upper Egypt; material which was particularly valuable because of the accurate manner in which it had been dated by Dr. G. A. Reisner. During the following years, amidst the onerous duties

[1] "The Archæological Survey of Nubia." Report for 1907–8. Vol. ii., Report on the Human Remains, by Drs. G. Elliot Smith, F.R.S., and F. Wood Jones. Pp. 378+vi plans. Plates to accompany Vol. ii., pp. 9+xlix plates. (Cairo: National Printing Dept., 1910.) Price 2 L.E.

of the medical school and the time absorbed by other lines of research, he found time to examine human remains which could be assigned to definite periods of a long period of Egyptian history, and thus lay the foundation of a knowledge of the physical history of the ancient inhabitants of the Nile valley.

In 1907, when it was resolved to heighten the Aswan dam, an opportunity occurred which allowed him to carry his researches among the ancient inhabitants of Nubia, and to compare them with their contemporaries in Egypt. Very wisely the Egyptian Government resolved to make a complete exploration of the ground which would become submerged when the dam was raised, and it was especially fortunate in the men selected for the task. Captain H. G. Lyons, F.R.S., was director, Dr. G. A. Reisner, archæologist, Prof. Elliot Smith, anthropologist. The work of exploration was commenced immediately above the dam, and by the month of October, 1907,

FIG. 1.—Grave 23 I. Burial assigned to the late Predynastic Period.

the remains of more than 2000 individuals, each with its full archæological history, waited the attention of the anthropologist. With his school duties in Cairo it was clearly impossible for Prof. Elliot Smith to undertake the task of examining these single-handed. By good fortune Dr. Wood-Jones, who had just returned from studying coral formation in the Cocos-Keeling Islands, was appointed to assist Prof. Elliot Smith and carry out observations in the field. During the winter 1907–8 forty-eight cemeteries were explored on both banks of the Nile, extending some eighteen miles above the Aswan dam. At the end of the winter the anthropological staff had made observations on about 6000 individuals, belonging to various periods, dating from predynastic to early Christian times—random samples of a local population through a period of 5000 years. The opportunity was unique; it may never occur again, and it is only just to add that Prof. Elliot Smith and Dr. Wood-Jones have availed themselves of it to the full. Their splendid records have now been published by the Egyptian Government in a form which deserves warm acknowledgment from archæologists and anatomists throughout the world. Ever since men began to inquire into the origin of the human species they have turned for light to the valley of the Nile.

In a remarkable opening chapter, Prof. Elliot Smith deals with the living thread of humanity that stretches along the Nile valley and links the negroid population of equatorial Africa with the fairer-skinned millions of Asia and Europe. During the last 6000 years that thread has changed remarkably little in character; at least when the curtain rises on it in predynastic times its composition is altogether modern in type and composed of a comparatively highly civilised community. It is true that in later times the head of the inhabitants becomes broader and the stature taller. Some have regarded the change in physique of the Egyptians as the result of civilisation. Prof. Elliot Smith does not deny that the environment of a higher civilisation may not have had its effect, but is inclined, from the evidence he has been able to adduce, to infer that the changes are to be sought rather (1) from an infiltration of a Levantine race, which entered lower Egypt at an early period and spread up the valley, and (2) from an infiltration of a negro element which entered the valley from the south. This at least is clear that there is a long period of Egyptian

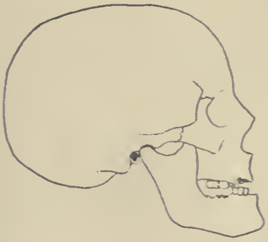


FIG. 2.—Skull of a man showing feminine characters.

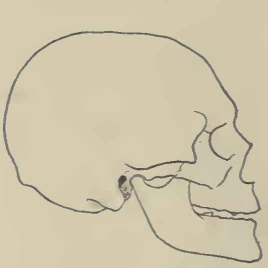


FIG. 3.—Skull of a woman showing masculine characters.

history beyond that which is now termed predynastic. The modern type of man is more than 6000 years old.

Some of the speculations regarding the racial constitution of the ancient Egyptians may prove to have only a passing value, yet the contributions made by Prof. Elliot Smith and Dr. Wood-Jones to certain problems which closely concern anthropologists are certainly of an abiding worth. It seems a comparatively easy thing to distinguish a man from a woman, but when it comes to the sexual and to the age distinction of the skeleton, and especially of the skull, the problem becomes a very difficult one. Dr. Wood-Jones gives accurate tracings of two crania (Figs. 2 and 3); one skull possesses all the characters of a male, but is really that of a woman; the other is that of a man, but has distinct female features. The pelvis, as one would expect, affords the best criteria of sex, and even it may show a certain degree of sexual mixture. Prof. Elliot Smith found by experiment that crania which were "sexed" according to their apparent characters were grouped wrongly to such an extent that the measurements made from such groups gave misleading data. It is very unfortunate that elaborate statistical tables have been prepared from crania which were thus classified. We are glad to note, too, that Prof. Elliot Smith thinks there is a future for anatomical as well as statistical observation in anthropology.

The account given by Dr. Wood-Jones of the physical characters, deformities, and abnormalities of

the ancient Nubians is full, accurate, and interesting, and provides a wealth of data which is quite new. His observations on their diseases and injuries opens a fresh chapter in pathology; for the first time we have a precise knowledge of the ailments and diseases of ancient races. No certain evidence of syphilis was found in Nubia, tuberculosis was extremely uncommon, rickets was unknown, but that chronic disease of joints, rheumatoid arthritis, was extremely common, especially in the predynastic inhabitants. Stone in the bladder and kidney occurred but seldom, but appendicitis evidently occurred, for in the illustration reproduced in Fig. 4, a band of adhesion—signifying a former inflammation of the appendix—is seen to pass across the pelvis of a young woman found in a cemetery of the Byzantine period. Gout was also known; and a sketch by Dr. Wood-Jones shows the basal joint of the big toe of a man loaded with "chalk" stones. Caries of the teeth, so prevalent now amongst European races, was unknown amongst the predynastic Egyptians, but in lower Egypt, it had appeared in the wealthier class by the time of the earlier dynasties. It did not become common until early Christian times in Egypt.

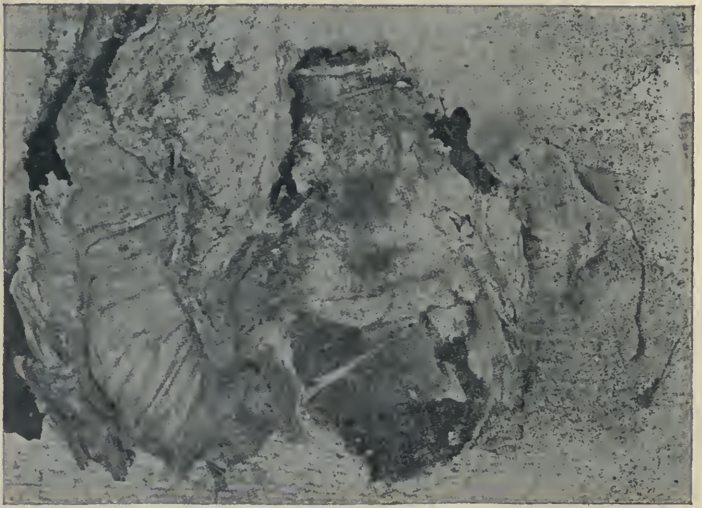


FIG. 4.—Pelvic viscera, showing an adhesive band attached to the appendix from a young woman of the Byzantine period.

There cannot be two opinions of the scientific value of the report prepared by Prof. Elliot Smith and Dr. Wood-Jones; they have made a contribution to our knowledge of racial anatomy and disease, of which the Egyptian Government and English anatomists may well be proud. But it is also clear that this contribution is only a first instalment to a very large and important subject, which must be studied now, otherwise the opportunity will have gone for ever. Both authors have returned to England, and it is greatly to be desired that the Egyptian Government will see that the work they have begun so well will be continued.

THE GERMAN EXCAVATIONS AT BABYLON.

OF all the societies that are engaged in the enormously important scientific work of disinterring the remains of ancient civilisation in the countries of the Near East, probably the most successful, in proportion to the length of time it has been in existence, is the "Deutsch Orient-Gesellschaft." Here, as in other matters, the German has come late upon the scene, but he has made up for his late appearance, not only by the amount of work he has done, but also by the way he has done it. Armed with ample funds derived from private subscribers, and made conspicuous by the special patronage of the German Emperor, the "Deutsch Orient-Gesellschaft" has carried on, or helped to carry on, excavations in Egypt, Palestine, Mesopotamia, and Asia Minor, which have produced results of the highest importance to the archæologist and to the historian of early civilisation. The excavations of the pyramids of Abusir, in Egypt, which date to the time of the Fifth Dynasty, have given us an entirely new idea of the art and religion of Egypt under the "Old Kingdom"; the disinterment of the ancient ruins of Jericho and Megiddo have made us realise better than before what the Canaanite civilisation was like; the discoveries of Dr. Winckler at Boghaz Kyöi have revealed to us a previously unknown period of the history of the Hittites, and those of Dr. Koldewey and Dr. Andrae at Babylon and Kala'at Shergat (Assur) have enabled us to study the actual ruins of the greatest city of the ancient world and of the oldest capital of Assyria.

The work at Babylon was the first undertaken by the society after its foundation eleven years ago. In March, 1899, work was begun on the Kasr, the "citadel" of Babylon, where are the ruins of Nebuchadnezzar's palace, and where he constructed the famous "Hanging Gardens" to please his Median queen, and make her fancy herself once more among the mountains, trees, and forests of her native land. Here was found an important monument in the shape of a *stela* of a Hittite king, which had been carried off by some Babylonian conqueror, probably from Carchemish. The great walls of the citadel, Imgur-Bel and Nimitti-Bel, have been uncovered, and the long "Processional Way of Marduk," between the two walls of Nimitti-Bel, have been revealed. Near by is the great mound, now called Tell 'Amrân ibn-'Ali, which covers E-sagila, the chief temple of Babylon's chief god, Marduk. And between this and the citadel is a space called *es-Sahn*, "the plate," in which stood a great *ziggurrat*-temple called Etemenanki. This building, E-sagila, and the neighbouring temple of Borsippa, compete for the honour of being the legendary "Tower of Babel." Dr. Koldewey seems to pronounce for the claims of E-sagila and Etemenanki against Borsippa, and has lately announced in an article in the *Berliner Tageblatt* that the excavation of the Tower of Babel "we now aspire to and expect." Whether E-sagila or Etemenanki, or the two together, are the basis of the legendary tower we do not know, but in any case the work will be of the highest interest. The execavations have also uncovered a temple of the god Ninib, E-patutila, and many streets; while the great palace buildings of the citadel, where Belshazzar's feast took place and Alexander died, have been shown to cover up on the river-side the remains of the quay walls built by Sargon and Nabopolassar.

Babylonian architecture was not beautiful, and in this, as in its use of enormous and imposing brick-masses, it reminds us strongly of the architecture of imperial Rome. As the brick at Rome was covered up by marble veneer, so at Babylon the brick wall-faces were often varied by coloured relief brickwork or hidden by coloured glazed bricks arranged in ornamental designs. The Gate of Ishtar at Babylon, discovered by Dr. Koldewey, has splendid decoration of both kinds, showing bulls guarding the gate. The

style of decoration with glazed bricks was borrowed by the Persians, and we see it in the splendid decoration from Persepolis now in the Louvre at Paris.

It is to be hoped that Dr. Koldewey has still more important discoveries in store. H. R. HALL.

THE NEGLECT OF GROUP-THEORY.

THE volume of "Proceedings of the London Mathematical Society," second series, vol. vii., contains twenty-six papers by such well-known mathematicians as Bateman, Bromwich, Burnside, Dickson, Dixon (A. C., and A. L.), Hardy, Harrison, Hobson, Lamb, Littlewood, Macdonald, Pidduck, Sommerville, and Young. While these are mainly of too technical a character to admit of discussion in this notice, attention should be directed to some remarks in Prof. Burnside's address on the "Theory of Groups of Finite Order," as affording an object-lesson on the important question of "England's neglect of mathematics." Prof. Burnside states :—

"It is undoubtedly the fact that the theory of groups of finite order has failed, so far, to arouse the interests of any but a very small number of English mathematicians; and this want of interest in England, compared with the amount of attention devoted to the subject both on the Continent and in America, appears to me very remarkable." "So far as I have been able to learn, no course of lectures has ever been delivered either at Oxford or Cambridge on the theory of groups of finite order." "In fact, so far as the teaching of the subject in England is concerned, one may say that it does not exist."

It appears that during the twenty-one years of the now, alas! defunct "Part II." of the Mathematical Tripos, questions on finite groups have only appeared four times, and that it is doubtful whether four candidates have seriously studied the subject.

On the other side we have the following statement :

"In Paris M. Jordan gives a course on the theory of groups of finite order at the Collège de France at regular intervals to an average class of six students, while the Galois theory of equations is lectured on at the Sorbonne and the École normal, as well as at one or two of the provincial universities.

"In most German universities, the regular course of lectures on algebra, attended by large classes of students, contains an exposition of the more elementary parts of the theory of groups of permutations. In addition to this there are, in all the larger universities, special courses devoted to groups of finite order and to discontinuous groups, which attract a considerable number of students. For instance, such special courses last year were attended at Göttingen by thirty students, and at Freiburg by twelve.

"In the United States all the leading universities offer regular courses in the theory of groups of finite order, with the exception of Harvard, where a course is given on the Galois theory of equations. In some cases the course is a yearly one, and in the others it is biennial. These courses attract from two or three up to ten or twelve students, who in general have already taken the B.A. degree."

Prof. Burnside offers some explanations for this neglect, but probably the reason is a very simple one. If any English mathematician specialises in the theory of groups (and at least one instance is known to the reviewer) no university will offer him adequate remuneration for a course of lectures on the subject; on the other hand, the mathematical departments of English institutions of university rank are deplorably understaffed in comparison with those in foreign countries, and their teachers are far too overburdened with elementary work to be able to start courses on a subject like "groups," in addition to meeting the necessary requirements of their examination syllabuses. Prof. Burnside suggests that the cause may partly be a lack of demand for instruction in the subject on the part of senior university students. But is it not the fact that such students are induced to give up advanced mathematical study and to take to experimental science in order to qualify for "research studentships?" If they persist in specialising in higher mathematics of any kind, they not infrequently do so at the risk of injuring their future prospects of obtaining appointments.

NOTES.

POLITICAL services and commercial prosperity appear to be the claims to distinction of most of the people whose names are to be found in the list of New Year Honours. The list includes the names of few men of eminence in the intellectual world—whether of science, art, or literature. One Fellow of the Royal Society—Dr. David Ferrier—has been knighted; and among the twenty-four other new knights are Dr. H. B. Donkin, Mr. G. Laurence Gomme, and Dr. G. Newman. Even in these cases, however, the honour appears to have been conferred for public services rather than in recognition of scientific work. The list has been received with the usual chorus of congratulation by the daily papers, but it can in no way be regarded as truly representative of the men who are rendering the best services to the nation.

THE Oceanographical Institute provided by the Prince of Monaco at Paris will be inaugurated on Monday, January 23.

IT is announced that an association for the promotion of science, to be called the "Kaiser Wilhelm Gesellschaft," will shortly be formed in Germany. The first meeting of the association is to be held within the next week or two under the presidency of Prof. Emil Fischer, and the German Emperor proposes to be present.

THE Paris Academy of Sciences, at a meeting on December 29, 1910, discussed the question of the election of women as members of the Institute of France. We learn from the *Times* that the academy eventually came to the conclusion that each section of the institute has complete independence with regard to the election of members, and that each academy has the right to decide the question of the election of women to its membership. The subject is being discussed at a general meeting of the academies as we go to press.

WE regret to see the announcement of the death of one of the best known supporters of amateur astronomy in Germany, Dr. M. Wilhelm Meyer, who died recently at Meran, at the comparatively early age of fifty-eight. Dr. Meyer's astronomical career began at Geneva, of which observatory he was for a short time director. He signalised his connection with that observatory by an attempt to determine the density of the material near the nucleus of a comet by observing the displacement of stars over which the comet passed; but he is better known from his relations with the Urania Gesellschaft in Berlin and his efforts to encourage astronomical studies in those who frequented the observatory. He was successful in attracting those who were capable of using the equipment provided wisely and well. Among his pupils or followers may be mentioned Herr Witt, who discovered the planet Eros in the Urania Observatory. Many of his popular works have had a wide circulation, among which may be mentioned "Das Weltgebäude," a work addressed to those who were capable of following the detailed explanation of the more difficult problems in astronomy, and the

"Spaziergänge durch das Reich der Sterne." He also wrote on comets and meteors in a way to attract attention and stimulate enthusiasm.

The Meteorological Office has, with the commencement of the present year, introduced considerable improvement in its Daily Weather Report. Dover has been discontinued as a reporting station, and Newquay has been added. The London observations are now taken at Kew, and not in St. James's Park as for some years past. The London area is, however, well served by supplementary observations given for Greenwich Observatory, City (Bunhill Row), Westminster (St. James's Park), and Hampstead. The graphic representations are greatly improved, and the area covered by the charts has been extended, so that the incorporation of the observations from the Atlantic Ocean received by radio-telegraphy will be much clearer.

The summary of the weather for the year just issued by the Meteorological Office with its Weekly Weather Report shows that the mean temperature for the several districts of the United Kingdom was nowhere very different from the average. The absolutely highest temperature reported in the British Isles was 83°, which occurred both in the east of England and in the Midland counties, and the lowest was minus 10°, in the east of Scotland. The rainfall for the year was in excess of the average, except in the north and west of Scotland. The greatest excess was 9·12 inches, in the Channel Islands, and this was followed by an excess of 6·83 inches, in the south-west of England. The heaviest aggregate measurement was 49·74 inches, in the north of Scotland, and the least 25·24 inches, in the north-east of England. The largest number of rainy days during the year in any district was 257, in the south of Ireland, the least 194, in the north-east of England, and 195, in the south-east of England. The duration of bright sunshine varied considerably in different districts, but there was a general deficiency except in some of the northern districts. In the north of Scotland there was an excess of 74 hours, and in the north-west of England an excess of 62 hours, whilst in the Channel Islands there was a deficiency of 159 hours and in the east of England a deficiency of 103 hours. A discussion of the Greenwich observations shows that the mean temperature for the year was 50·4°, which is 0·3° in excess of the average. The highest monthly mean was 62·2°, in August, the lowest 38·7°, in November. In November the mean temperature for the month was 4·7° below the average of sixty years, and in July it was 4° below the average. In December the mean was 5° in excess of the average, and in October it was 3·5° in excess. The absolutely highest temperature was 82°, in June, the lowest 20°, in January. The greatest range in any month was 48°, in May. There were only two warm days with the temperature above the average in July, and only three in November, but there were about twenty-six warm days both in October and December. November had as many as fifteen frosty nights. The aggregate rainfall was 28 inches, which is 4 inches more than the average, and, with the exception of 1903, it was the heaviest rainfall for thirty years. July was the wettest month, with 3·55 inches, and September the driest, with 0·72 inch. The duration of bright sunshine was about 115 hours' deficient for the year. May was the sunniest month, with 219 hours, and December the least sunny, with about 30 hours.

Several earthquake shocks have been recorded during the past week. According to Reuter messages, continuous shocks were experienced in the province of Elis, Greece, on December 29, 1910. On December 31 a distinct earth tremor, lasting several seconds, was felt at San Francisco at 4.41 a.m.; and on January 1 a strong shock was felt at Brusa, in Asiatic Turkey.

A telegraphic message from the ss. *Cedric* to the Marconi Wireless Telegraph Company on December 29, 1910, published in the *Times* of the following day, stated that the ship had been in communication with the English and French coasts at 1250 miles distance, and with Flores Island on three successive days. The ship was in communication with the European and American coast every day of the passage, and was at the time of telegraphing 1140 miles from New York.

The Elizabeth Thompson Science Fund was established by Mrs. Elizabeth Thompson, of Stamford, Connecticut, "for the advancement and prosecution of scientific research in its broadest sense." The income from this fund is now available, and the trustees desire to receive applications for appropriations in aid of scientific work. The trustees are disinclined, for the present, to make any grant to meet ordinary expenses of living or to purchase instruments, such as are found commonly in laboratories. Decided preference will be given to applications for small amounts, and grants exceeding 60*l.* will be made only in very exceptional circumstances. Applications for assistance from this fund, in order to receive consideration, must be accompanied by full information, especially in regard to the following points:—(1) precise amount required; (2) exact nature of the investigation proposed; (3) conditions under which the research is to be prosecuted; (4) manner in which the appropriation asked for is to be expended. All applications should reach, before February 1, the secretary of the board of trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass., U.S.A.

Mr. F. C. Selous has been commissioned by the trustees of the British Museum to undertake an expedition to the southern district of the Bahr-el-Ghazal or Lado for the purpose of procuring the head and skin of an adult male of the Sudani race of Lord Derby's eland (*Taurotragus derbianus gigas*). As these antelopes appear to be of a wandering disposition, it is by no means easy to know where to light upon them, and even when found it is somewhat difficult to decide whether to select, for museum purposes, a comparatively young bull with long, unworn horns and a short frontal "brush," or an older animal with shorter horns but a fully developed brush. At present this eland is represented in the exhibition galleries of the natural history branch of the museum by the mounted head of a female and a male skull and horns. Mr. Selous, who has our best wishes for success, starts, we believe, almost immediately.

A correspondent of the *Times* of December 28, 1910, records the discovery of what may be called an Arabic Pompeii in the neighbourhood of Cordova. The discovery of this pleasure-resort of the great Khalif Abderrahman III., who erected it between 936 and 961, has been jealously concealed by the Spanish archæologists, and came to light accidentally through the examination of certain fragments of Arabic sculpture of the tenth century recently deposited in the Museum of Cordova. The remains may be assigned to the Egyptian or Copto-Arabic school, and among them the most remarkable are the specimens of glass work with a silver sheen, the secret of which has long been lost, and the painted and glazed pottery made out of calcined clay. So far, the excavations

appear to have been most inefficiently conducted, and much valuable material has been destroyed. It may be hoped that the Spanish Government will now arrange for the scientific examination of a site which is likely to supply much information on a little known chapter of the history of Moorish art.

MR. D. CARRUTHERS, in conjunction with Mr. J. H. Miller and Mr. M. P. Price, left England in March last with the object of exploring zoologically, botanically, and, so far as possible, geographically, the upper part of the basin of the Yenesei and the western frontier of Mongolia. The expedition started in May from Minusinsk, on the Yenesei, up to which point that river is navigable, and finally reached Kuldja on November 14, in the Ili valley in the Tian-shan range, having successfully accomplished the journey along western Mongolia. A preliminary account was given in the *Times* of December 30. 1910, from which it appears that the expedition had first to traverse a belt of virgin forest, which extends in this region from the Yenesei to the Baikal lake, and then passed over a range 5000 to 7000 feet high into an upper basin of the Yenisei. This basin was inhabited thinly by tribes of Finno-Tartar stock, who reside partly in the forest and partly on the more open country of larch groves and pasture land. The forest people are occupied in hunting and herding their domesticated reindeer, of which two breeds were met with. Wild reindeer were also found to occur on the higher parts of the hill ranges above the forests. The western part of the basin was found to be more arid than the forest-clad eastern portion, and in it the inhabitants lived in felt tents. Everywhere signs abounded of former settlements and of an earlier and more advanced civilisation, and evidence seemed to point to an increasing desiccation of the region having been the principal cause of its desiccation here as in other parts of Central Asia. In passing south to Kuldja on the approach of the winter season across the basin of the Upper Irtish, vast deposits of fine mud now being eroded by the hill-streams were met with, and it is suggested that these were deposited in comparatively recent times, when there existed a vast inland sea covering all the river basins of this region, and of which the lakes Balkash, Ala-Kul, Ebi-Nor, &c., are the vestiges. The route for next season may be eastwards along the Tian-shan range to the western margin of the Gobi desert.

IT has been long known that there is a considerable bed of low-grade iron ore in the Jurassic rocks of some of the western isles of Scotland, and especially in Raasay. The deposit there has been described by Mr. H. B. Woodward in the Memoirs of the Geological Survey, and analyses published by him showed that the ore agrees in general character, as well as in geological horizon, with the Cleveland ores of Yorkshire. The deposit in Raasay, an island off the north-eastern coast of Skye, covers an area of some 28 square miles. Prospecting work on the deposit has been conducted for some time past by Messrs. Wm. Baird and Co., of Glasgow, and it is now announced that they have secured an option for the purchase of the island, and that they propose to erect blast furnaces there for the smelting of the ore. The extension of the ore bed in Skye has also been examined, but with less promising results. The Raasay ore is of low grade, but its position allows of inexpensive mining. The ore will be used for the production of foundry pig iron.

SOME particulars of the proposed work of the German Antarctic Expedition are given by the Berlin correspondent of the *Times* in the issue for January 4. We learn from this source that the Antarctic expedition, under the command of Lieut. Filchner, will leave Germany early this year for Buenos Aires, and will proceed from there at the beginning of October *via* South Georgia and the Sandwich Islands to the Weddell Sea. On arrival in the Weddell Sea it is proposed to establish a base station on the eastern coast so far south as possible, with the necessary equipment for a year's research. A party of ten men will be landed, of whom six—a geologist, a meteorologist, an astronomer, a doctor who is also a biologist, a cook, and a sailor—will stay in the station, while the remaining four will undertake a long sledge expedition into the interior of the South Polar continent. Meanwhile the ship will return to the Atlantic Ocean to carry out coastal observations and oceanographical work. At a meeting held on January 3 in the building of the General Staff, with Prince Henry of Prussia in the chair, the treasurer of the committee which is arranging for the expedition announced that a sum of about 41,250*l.* is in hand. The cost of the vessel and equipment have amounted to 14,500*l.*, and the total cost of the expedition is estimated at 70,000*l.* A lottery has been authorised by the Federal Council, and is expected to produce not less than 27,000*l.*

THE expedition of the British Ornithologists' Union to Netherlands New Guinea, continues to labour under extreme difficulties, and the experiences of its members confirms the opinion that New Guinea is one of the most difficult places in which to travel. The jungle which the expedition has encountered is almost impenetrable, and is described as "dismal, dark, dripping," abounding with noxious insects and leeches. The strain and illness have so told on Mr. Goodfellow, the leader, that he has had to return home. Earlier accounts stated that very short people had been met with; the last account describes a true pygmy race inhabiting "the foot-hills of the mountains. These shy and treacherous pygmies, who average 4 feet 6 inches to 4 feet 8 inches in height, wander over the heavy jungle-clad hills and mountains, subsisting on roots and jungle produce, hunting the wallaby, pig, and cassowary, and fishing in the mountain torrents. They dwell in the rudest kind of lean-to huts made of branches and fan palms, with no regular villages, but moving from district to district in search of food. The only metal tool they possessed was a small wedge-shaped piece of iron, 1 inch by 2 inches, inserted into a wooden handle, and answering the purpose of an axe, and with this a whole 20-acre clearing had been made. None but those who have worked and toiled in this dense jungle can really appreciate the perseverance and patience necessary to accomplish this, for many of the trees are from 12 to 15 feet in circumference. This piece of iron was traded up from the coast natives."

ON Tuesday, December 20, 1910, in a paper read before the Royal Colonial Institute on the birds of our colonies and their protection, Mr. James Buckland brought a further heavy indictment against the plume-hunter and his trade in our colonies and dependencies, and a powerful appeal in favour of the prohibition of the import of trade feathers. In Australia, New Guinea, New Zealand, India, and the West Indies, the most beautiful members of their avifauna are apparently being so ruthlessly destroyed as to make it no difficult matter to predict their comparatively early extinction. As an example of the havoc wrought by these hunters, Mr. Buckland instances, among many other battues, the slaughter on the island of Losiansky, near Lysan, one of the bird-reservations

established in the Pacific by the United States, of 300,000 sea birds before the descent of the Government cutter put a sudden stop to their proceedings. The author of the paper emphasises the enormous value of birds in our tropical and subtropical colonies from an economic point of view, and pictures what would result from the extinction of such species as the straw-necked ibis, which saves the Australian paddocks in their periodical ravages by grasshoppers, of which twenty-five tons can be devoured in a single day by 200,000 of these useful insect eaters. Protection of colonial birds, he pleads, is called for also in the interests of sentiment and hereditary association. "Which is it to be," he asks, "the bird, alive, filling the land with song and beauty and labouring unceasingly for the good of millions of our kinsmen, or the bird, dead, and irreparably lost to our colonies, that a few individuals, whose number is composed largely of the foreign element, may put money in their pockets?"

MR. HAMEL SMITH forwards us, in reference to the review of his book, "Aigrettes and Bird Skins," in NATURE of December 15, 1910 (p. 207), a number of extracts—unfortunately too long for our limited space—from various notices dealing with the book in the colonial and Indian Press, many of them supporting "a fair hearing for both sides prior to the passing of enactments," and reminds us that his book "suggests the establishment of a close season generally and total prohibition of shooting at any centre where the birds show serious signs of diminishing." In reply to this communication our reviewer repeats that the difficulties and expense of effectively maintaining a close season are prohibitive. The plume-hunter, moreover, apparently devoid of conscience, ignores all laws, regulations, and enactments. The nuptial period is his only harvest time; if stopped in that season his occupation would be gone. The facts already sufficiently established prove that the trade is conducted with the utmost cruelty, that the extermination of many economically valuable species is imminent, and that no close season will effectively stop the slaughter of ornate birds so long as such great emporia as London and other Continental cities remain open. In centres where extermination is imminent, even if proclaimed, the plume-hunter will carry on his trade by stealth when he cannot openly, and will ship away his harvest as "cow-hair," "horse-hair," or under any other specious designation likely to pass the custom house.

IN a lengthy letter to the *Times* of December 26, 1910, Dr. Bulloch makes an earnest appeal for the adequate endowment of medical education and research. He points out that the better educated the medical man, the greater the gain to society in general who requires his services. Medical education at present is so expensive that the cost is less than half covered by the fees of the students. We have hospitals unrivalled in the world, but it has been decreed that the generous contributions of those who support them must not be applied to medical education. The public demands the greatest efficiency, yet with few exceptions fails to provide the institutes which are necessary for the training. The donations of generous donors for medical research, such as those of city companies and of Mr. Carnegie and the Beit scholarships, to some extent miss their aim. In the main they go to the researchers, but neglect to provide these with laboratories and training for their work. The teachers who have to train them are overworked and inadequately remunerated; they themselves might, had they the time and opportunity, form the mainstay of medical research in this country. But the research scholarships are usually awarded to relatively young men, and their teachers obtain no help, financial or otherwise.

THE *Psychological Review* for November (1910) contains a paper by Mr. T. V. Moore on the influence of temperature and the electric current on the sensibility of the skin. The author finds that the minimum threshold for touch and for spatial threshold is reached when the temperature of the skin is about 36° C., above and below which point the threshold rises. He also concludes that Pflüger's law for the irritability of motor nerves and muscles holds for cutaneous sensibility, which is accordingly decreased at the anode and increased at the kathode pole. Mr. Moore finds that, immediately after the subjection of a skin area to the induced electric current, the sensibility of the touch spots and of the pain spots is lowered considerably, and he believes that under these conditions a touch spot may function as a pain spot.

ACCORDING to an article by Mr. L. E. Hope, the curator, published in the *Museums Journal* for December, 1910, a local natural history record bureau has been established at the Carlisle Museum. The area of observation includes a radius of fifty miles from the city, and it is to be hoped that an increase in the local fauna list will be the result of the movement. The scheme has been in operation since 1902, and during the last few years the annual number of notes has been between 200 and 300 annually. The idea may be commended to other local museums.

ACCORDING to an article in the *Times* of December 23, 1910, the relatives of the late Mr. Boyd Alexander are about to present, in accordance with the wishes of the deceased, his large collection of African birds to the British Museum. The specimens are about 4000 in number, and include several species (whether the types is not stated) discovered by the late explorer, among the most interesting of these being Willcocks' honey-guide (*Indicator willcocksi*) and the long-tailed tree-warbler (*Urolais mariae*), the latter representing a generic type of its own. The first portion of the collection was made in the Cape Verdes, a second portion during the Kumasi relief expedition, a third when Mr. Alexander led a column to Gambaga, a fourth in the course of the Alexander-Gosling expedition from the Nile to the Niger, and the last in the islands of the Gulf of Guinea and the Cameruns.

MUCH interest attaches to a note, by Mr. E. Bidwell, in the October (1910) number of the *Ibis* (ser. 9, vol. iv., p. 759), on fragments of the egg of an ostrich obtained some years ago in a nalla on the Kain River, in the Banda district of the United Provinces of India. Structurally the shell is almost identical with that of the Somali *Struthio molybdophanes*, but the thickness is somewhat greater. The name *S. indicus* is proposed for the species represented by the Banda egg-fragments. It may be mentioned that in ancient literature there are references to the occurrence of large birds in Central Asia, not improbably inclusive of Baluchistan, which could scarcely have been other than ostriches, while in old Chinese works there is mention of ostrich-eggs sent as presents to the emperors. The Assyrian sculptures show, moreover, that ostriches formerly inhabited Mesopotamia. Sub-fossil egg-shells indicate the occurrence of a species (*S. chersonensis*) in the Government of Cherson, in south Russia, while in the Pliocene we have remains of *S. karatheodori* from Samos and of *S. asiaticus* from northern India.

THE nature of the colouring of the kingfisher is discussed by Mr. F. J. Stubbs in the *Zoologist* for December, 1910. According to the angle of vision and the position

of the spectator with regard to the light, the colour of the feathers on the back of the bird ranges from ultramarine and cobalt, through green, to straw-yellow. The outer layers of the feathers are transparent, and may be removed without interfering with the underlying colour, which is not due to pigment. Beneath the outer layer is a pavement-like arrangement of polyhedral cells, the tops of which are the source of the blue colour. These caps are slightly convex, and when seen by reflected light are blue on both sides. In the author's opinion the origin of the colour may be explained by "the theory of the production of blue by the reflection of light from small particles, and of orange or red by the transmission of light through small particles." It is, in fact, precisely analogous to the colour of the air, the full blue appearing when the feathers are seen by diffused reflected light, while at a low angle, when the light is in part transmitted, the straw-yellow results.

A MONTHLY journal entitled *Peru To-day* is published to give an account of Peruvian development, and from it we learn that the principal cotton-producing districts are near the coast, and are usually vast desert-like valleys irrigated from the rivers flowing from the Andes to the Pacific. Canal irrigation is adopted, and the growers have acquired considerable skill in management. The sugar cultivation is being improved by the introduction of labour-saving devices and more modern machinery; attention is also being paid to drainage. The yield on well-managed estates is very considerably above the average of the country, a fact which indicates that there is still considerable scope for development. An experiment station has been established at Lima for working out agricultural problems.

THE interesting little booklet entitled "West Indies in Canada," that has been drawn up for the Canadian Exhibitions at Toronto and St. John's to give information about the resources of the West Indies and British Guiana, will appeal to a much wider audience than such publications usually find. It contains a map of the West Indies and tables showing their chief exports and imports; then follows an account of each island, including a short history and general description, an account of the climate and sanitary conditions, and of the industries. Unfamiliar crops and operations such as planting bananas are illustrated. A list of books dealing with the West Indies is included, and finally an alphabetical list is drawn up of the products, with a sufficient account of each.

THE Proceedings of the University of Durham Philosophical Society is always an interesting volume, and the current number (part v., vol. iii.) fully maintains the standard set by its predecessors. Mr. Gray reports a severe attack by a furniture pest, *Glycyphagus domesticus*, de Geer, on the contents of the dining and drawing rooms of a new house in Newcastle, which did so much damage that all the infested furniture was destroyed. Prof. Potter describes experiments showing the difference of potential set up by the activity of micro-organisms in culture solutions, and Mr. Horne and Miss Coull give an account of their work on the absorption of water by the seeds of *Vicia Faba*. Engineering subjects are represented by Mr. Eden's paper on the endurance of metals under alternating stresses, and Mr. Dixon's paper on torsional vibrations of massive loaded shafts.

THE Board of Agriculture issues each month an excellent Journal containing papers on technical subjects of importance to farmers, market gardeners, and others, as well as shorter articles and notes on crops, markets, &c. Recent issues contain an article by Mr. K. J. J. Mackenzie, in which he develops his well-known studies of the "points" of livestock, showing how they may to some extent be reduced to actual measurement, and thus become susceptible to exact treatment. Mr. Sawyer gives an account of the sugar beet grown for export in Norfolk, but considers that the price offered—17*s*. 6*d*. per ton—was barely sufficient; he thinks that 20*s*. would have to be offered by factories starting in England. Dr. Russell gives some new analyses of seaweed, and shows that it contains notable quantities of fertilising material; unfortunately, no economical method has yet been discovered of working it up into a saleable manure.

IN the Bulletin of the Imperial Academy of Sciences of St. Petersburg, No. 13, 1910, M. I. P. Tolmachef reports the changes made in the map of the coast between the rivers Khatanga and Anabar by his expedition in 1905. Cape Preobrazhenie is removed more than half a degree to the south. The east coast of the Khatanga Gulf was found to be very irregular, jutting out into three large peninsulas separated by deep inlets, and the St. Nicholas Island does not exist. The entrance to Nordvik Bay faces north, not west. The actual coast-line is marked in red on a cutting from the 100-verst map of Asiatic Russia.

THE Memoir of the Imperial Russian Geographical Society (Statistical Section, vol. x., No. 2) consists of an essay by M. Semionof-of-Tian Shan, on the towns and villages of Russia and their distribution in relation to physical conditions and historical events. The country is divided into three main divisions: the centre and north-west, where agriculture thrives on the watersheds; the northern, where the climate is severe and rural industries (fishing, lumbering, &c.) are pursued on the rivers and lakes; and the black soil of the south, exclusively agricultural, where the population is concentrated in the valleys. The towns are divided into groups according to population and regions, and are treated in connection with the non-rural industries (mining, manufacture, trade, &c.) to which they chiefly owe their origin. Fifty per cent. of the urban population is concentrated on the shores of the Baltic. The article is accompanied by a general map and many sketch-maps illustrating especial subjects.

As the irrigation system in Egypt is continuously being developed, the margin within which improvements may be made becomes narrower, and factors which at first were of minor importance have now to be studied. In the November (1910) number of the *Cairo Scientific Journal* Mr. J. Murray contributes a study of the seepage and evaporation loss from the Ibrahimia canal, which waters the greater part of Middle Egypt. A reach of 132·5 kilometres is investigated, having a width of from 38 to 55 metres between Deirut and Maghagha, and is treated in four sections; in these the loss is found to be 3·9, 2·8, 2·0, and 0·8 metres per second in proceeding from Deirut down stream, and a formula is proposed for reckoning the loss in similar canals in Egypt.

IN the *Cairo Scientific Journal* for November (1910) Mr. H. E. Hurst describes a visit made to some of the oases in the Libyan desert when extending the magnetic survey of the Nile valley to the westward. Traces of the old Egyptian practice of astronomical observation were found in Dakhla oasis in the method of dividing up the day into periods for supplying the water from the flowing wells, and in utilising the rising or setting of certain stars for distributing the water to the land of different shareholders in the water of the spring. The same custom prevails in Baharia oasis, and also in Nubia, where the water is raised from the Nile by water-wheels worked by

cattle, and then distributed on the land of each owner in turn.

AT the meeting of the research department of the Royal Geographical Society on December 15, 1910, papers were read by Miss M. Pallis and Mr. R. Gurney on the saline water of that portion of the Norfolk Broads which is drained by the rivers Thurne and Bure. Evidence was brought forward to show that such salinity was only directly due to the tidal water of the sea in the case of the Bure, but in the basin of the Thurne salinity increases inland, and is greatest in Horsey Mere, which is fed by a layer of salt water which percolates from the sea coast and extends to some height above low tide-level. Similar conditions were cited from Holland, where much attention has been given to the mapping of such salt-water table.

AN article relating to the decrease, in recent years, in the frequency and intensity of London fog appeared in the *Times* of December 27, 1910. The statistics given, based on information published by the Meteorological Office, are illustrated by two diagrams, in which the prevalence of fog and bright sunshine in London are shown, in triennial means, by curves. These diagrams are supplemented by the following table:—

	Days with fog	Hours of bright sunshine
1st nine winters, 1883–4 to 1891–2 ...	29·9 ...	55·6
2nd ,, ,, 1892–3 ,, 1900–1 ...	20·7 ...	70·1
3rd ,, ,, 1901–2 ,, 1909–10 ...	10·6 ...	93·5

The curve relating to fog shows an increase in frequency during the first nine years, a decline subsequently, rapid at first, afterwards gradual. The curve of bright sunshine, although irregular, exhibits a tendency for an increase during the twenty-seven years; since the winter of 1901–2, only one season had fewer than the normal record. Reference is made to a discussion on the subject which took place six years ago at a meeting of the Royal Meteorological Society, when the respective speakers attributed different causes to the improvement in the air of London. The opinion favoured by the writer of the article is that the improvement is due to the more vigorous enforcement of the smoke-prevention clauses of the Public Health Act, the use of gas fires for heating and cooking, and improved methods of lighting. As regards the quality of London fog, these are probably the true reasons; fog, however, usually occurs when an approximation to uniformity of pressure gives rise to a state of stagnation in the atmosphere, and is frequently, though not necessarily, associated with anticyclonic conditions; moreover, the geographical position of London favours the occurrence of fog.

THE present position of Antarctic meteorology is the subject of an interesting and instructive article, by Mr. R. C. Mossman, in the Quarterly Journal of the Royal Meteorological Society for October last. He points out that our knowledge of Antarctic climate, as relating to a continental surface, depends on sledge journeys, the fixed observing stations being largely affected by oceanic influences. One of the most striking features shown by the records at the stations is the low summer temperature to the north of the Antarctic circle, due to pack-ice and to the frequency of fog in low latitudes. The useful tables accompanying the work show that the lowest of the annual mean temperatures was $-1·3°$, observed by the *Discovery*, being 8·4° lower than that at Cape Adare, some 400 miles to the north. The absolute minimum, observed by the same ship, was $-58·5°$, but considerably lower readings were recorded on sledge journeys. Precipitation is most difficult to estimate, owing to drifting snow; in the Victoria Land region the Shackleton expedition found an annual fall equal to about 9½ inches of rain. The author estimates the annual amount for the land surface of Antarctica at about 12 inches. The winds are from an easterly direction, but at heights exceeding 15,000 feet the air moves polewards. The Shackleton expedition recognised two high-level currents, the upper from a northerly and the middle from a southerly quarter. The author observes that the subject requires further study, and that after the Pole is reached there will be little inducement for enterprises of a record-breaking character, and then some solid scheme of purely scientific research could be set on foot with some prospect of success.

THE *résumé* of the meeting of the Société française de Physique on December 2, 1910, contains a short account of M. Perot's paper on the luminescence of the mercury arc *in vacuo*. The observations were made on arcs formed in a spherical vessel 10 cm. diameter, the current flowing along a diameter. At very low pressures the discharge fills the whole of the vessel, and has a white appearance. As air is allowed to enter, the discharge concentrates itself and becomes a rose-coloured column not unlike the positive column in a vacuum tube. Mercury is transported from the anode to the kathode. Water vapour destroys the luminescence. An examination of the green line of the spectrum shows that while the principal component is reversed and displaced towards the red as the pressure is increased, the principal satellite is unaffected by pressure. When observed in light emitted in the direction in which the current is flowing and in the reverse direction, respectively, it shows that the luminous centres are travelling with the current with velocities of 30 to 350 metres per second, according to the pressure. M. Perot concludes that the light emission is due to the mercury atoms set in vibration by the impact of electrons, that these atoms encounter inert atoms which they set in motion without rendering luminous, and at each encounter the phase, but not the energy, of the vibration is changed.

A NOTE in the *Builder* for December 31, 1910, gives account of a contradiction to the generally accepted idea that asphalt paving or lining is a barrier to vegetation. The courtyard at the Bank of Italy, in Rome, includes a small garden planted with shrubs, and particularly with Dracæna and Chamærops. Beneath the court is a basement covered by masonry arches, the extrados of which is protected by a layer of asphalt seven-eighths of an inch thick, with the object of preventing the percolation of moisture into the chamber where documents are stored. Some little time ago it was noticed that damp patches had appeared on the ceiling, and that the size of these increased rapidly. On removing the earth from above the masonry it was found that several roots of Chamærops had penetrated right through the asphalt, the holes being of about 0·25 inch in diameter, and almost as clean as if bored by a tool. Being unable to pierce the masonry, the roots had forced their way between it and the asphalt, and, some of them having perished, left holes, through which water passed freely.

COMMENTING on the accident on the Midland Railway at Hawes Junction, the *Engineer* for December 30, 1910, considers that the question of safeguards against fire in trains after collision is not very easily settled. The substitution of electric light for gas is a recommendation which does not meet the whole case. Live coals ejected from the fire-box by the collision have been responsible for starting fires; it is on record that an electrically lighted coach was so destroyed in the Grantham accident; again, the two coaches which first caught fire at Cudworth were so illuminated. The small inverted incandes-

cent gas mantles now employed give an excellent light much appreciated by passengers, and gas commends itself to the companies on account of but little skilled attention being required. Points which might be considered are a more generous use of steel in the body of the coach, and the adoption of fire-proof paint, as on the District Railway. Extinguishers and a few fireman's tools might be provided in every guard's van. Lastly, it might be asked whether it is not possible to reduce the chances of telescoping? It is only natural that the two front coaches of the train in question should be crushed; they were situated between two engines and a sleeping-car weighing about 40 tons. A uniform weight for passenger-carrying vehicles would appear to be a point worthy of attention.

OUR ASTRONOMICAL COLUMN.

Discovery of an Eighth-magnitude Nova.—A telegram from the Kiel Centralstelle announces that a new star was discovered by Mr. Espin, at Tow-Law, on December 30, 1910. Measurements were made at 7h. 35·9m. G.M.T., and the position of the nova is given as

R.A. = 22h. 32m. 9·5s., dec. = 52° 15′ 21″ N.

This is just circumpolar in our latitudes, and, as the object is at present of the eighth magnitude, numerous observations should be possible, weather permitting.

This object will be known as Nova Lacertæ, as it lies in that constellation, forming the apex—to the north-east—of an approximately equilateral triangle, of which the base is the line joining α and β Lacertæ; it lies in the southern border of the Milky Way in that region. As Lacerta transits during the afternoon, observations should be possible during the greater part of the evening, and as Mr. Espin records "bright lines," spectroscopic observations are desirable wherever possible.

Later reports state that the star is red, and that bright helium and hydrogen lines have been seen in the spectrum. Photographs of the nova were taken at Greenwich on December 31, and the magnitude was reported as 7·5.

Metcalf's Comet, 1910*b*.—A continuation of Dr. Ebell's ephemeris for comet 1910*b* appears in No. 4462 of the *Astronomische Nachrichten*. The present position of the comet lies in Corona at 15h. 52m., +36° 45·4′, and is moving northwards and slightly towards the west; the magnitude is nearly constant at 12·0. Although not very favourably placed for observation, the comet may still be observed during the hours of the early morning.

Elements for Faye's Comet, 1910*e*.—From observations made on November 11, 18, and 25, Prof. Ristenpart and Dr. Prager have calculated new elements for comet 1910*e*, and now publish them in No. 4462 of the *Astronomische Nachrichten*. These elements confirm the identity of the comet with Faye's comet, and give the time of perihelion passage as 1910 October 30·04 G.M.T.; the eccentricity of the orbit is given as 0·5169, and the comet's period as 5·96 years.

A set of elliptic elements, calculated by Mr. Meyer and Miss Levy, of the Berkeley Astronomical Department, and published in No. 186 of the Lick Observatory Bulletins, gives the time of perihelion passage as 1910 November 12·413 G.M.T., the eccentricity as 0·5459, and the period as 6·926 years.

A New Map of the Moon.—A map of the moon, prepared by Mr. Goodacre, was exhibited during last session at the Royal Astronomical Society, and was enthusiastically received by the selenographers present. Mr. Goodacre now proposes to have the map reproduced on such a scale that the lunar diameter will be 60 inches, and to issue it in the form of twenty-five separate charts, each 13 inches square. If 200 subscribers are forthcoming this can be done at the price of 22*s.* 6*d.* per set. The map shows all the known lunar features, their accurate delineation depending upon the positions of 1433 points given in Mr. Saunder's memoir (the *Observatory*, No. 429).

The Total Eclipse of the Moon, November 16, 1910.—Reports of the observations made at a number of Continental observatories during the total lunar eclipse which took place on November 16 appear in No. 4460 of the *Astronomische Nachrichten*.

Dr. Max Wolf gives the times of entry and exit of various features as recorded by a number of observers at Heidelberg; detailed observations of the various colorations of different features are also reported.

Father Fenyi, at Kalocsa, also records colours and remarks on the general brightness of the eclipsed surface; at 12h. 33m. 12·37s. G.M.T. he observed the occultation of the star B.D. + 18° 489.

Occultations and colour variations are also recorded by Herr Mündler, Prof. Küstner, and Dr. Courvoisier.

Nineteen Stars with Newly Discovered Variable Radial Velocities.—In a paper appearing in vol. xxxii., No. 4, of the *Astrophysical Journal*, Mr. O. J. Lee gives the measures of the spectra of nineteen stars which have recently proved to be spectroscopic binaries. The spectra were photographed at the Yerkes Observatory, the dispersion of one prism being usually employed. The stars are σ Andromedæ, ι Cassiopeiæ, ρ Tauri, ν and ϕ Geminorum, 42 Camelopardalis, γ Cancri, θ Hydræ, σ Leonis, 23 Comæ Berenices, η and γ Coronæ, ι and π Serpentis, γ Ophiuchi, ϕ Sagittarii, 13 Vulpeculæ, 16 Lacertæ, and α Pegasi.

The multiple character of some of these stars was announced by Prof. Frost and Mr. Lee at the Cambridge meeting of the Astronomical and Astrophysical Society in August, but ι Cassiopeiæ, γ Ophiuchi, and α Pegasi are now included for the first time. Some of these binaries are members of visual multiple systems, and in others the examination of the H and K lines suggests that the stars may belong to that class of binaries in which the calcium lines appear to have a constant velocity.

Observations of Planets.—The December (1910) number of the *Bulletin de la Société astronomique de France* contains some interesting notes, by M. J. Halley, on observations of Venus made at Roubaix during 1909–10.

M. Halley used a Secretan refractor of 135 mm. aperture, and was favoured with excellent atmospheric conditions. He records, in addition to the bright polar areas, several markings which persisted during his observations; the chief of these is a pair of dark streaks, divided by a bright lane, running from the terminator towards the south; a dark patch, which appeared to lengthen, in the northern hemisphere near the bright limb; and a dark area bordering the bright area at the north pole.

Several of the photographs of Saturn exhibited by Prof. Lowell are reproduced to illustrate a paper on planetary photography which appears in the November (1910) number of the Bulletin.

COLOUR CONTRAST IN PHOTOMICROGRAPHY.

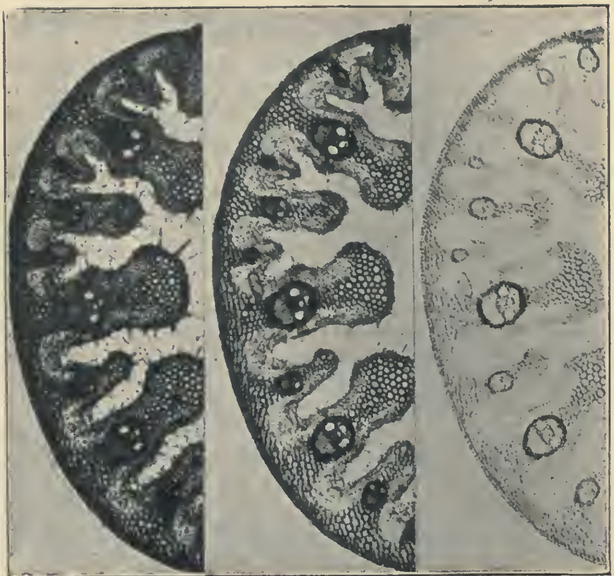
The latest of the series of booklets issued from the laboratory of Messrs. Wratten and Wainwright, Ltd., Croydon, deals with photomicrography. This booklet differs from most of the more pretentious works dealing with photomicrography in that but little attention is paid to the instrumental side of the subject, which is dismissed with only a few words of practical advice, attention being concentrated upon the relation between colour and contrast, especially from the point of view of the photography of stained sections.

A perusal of most books on photomicrography indicates that the more difficult parts of the subject technically, such as the high-power photography of diatoms or minute bacteria, receive a somewhat undue amount of attention compared with their importance to the average worker in science, the difficulties which less expert workers find in obtaining really first-rate photographs of sections or preparations being somewhat apt to be overlooked. The greatest difficulty found is usually that the contrast between the structure to be examined and the background is insufficient, and the main control of contrast is supplied by the colour of the light used for illumination.

A coloured object is, of course, coloured by virtue of the property which it possesses of absorbing some of the constituents from white light; if the light reflected from

such a coloured object be examined by means of a spectroscope, it will be found that a portion of the spectrum is partly or completely missing. This missing portion appears as a black band, which is generally known as the absorption band of the colour. If a particular object absorbs most of the constituents from white light, so that only a small portion of the spectrum is transmitted, then that portion may be referred to as the transmission band.

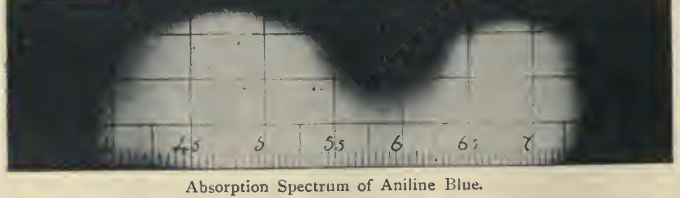
Since the light which is not absorbed falls upon the eye, the sensation of colour produced is the reverse, or complementary, to the colour which is absorbed, so that a light-blue object has an absorption band in the red of the spectrum, a magenta in the green, an orange in the blue-green, and a yellow in the blue-violet. Now this consideration shows that if a colour is to be rendered as black as possible, then it must be viewed or photographed by light which is completely absorbed by the colour, that is, by light of the wave-lengths comprised within its absorption band.



W.L. 5000 to 5400 5700 6400

Photomicrographs of an Eosine stained section.

A useful example is given by the photomicrographs of a section stained with eosine; this section appears pink, eosine absorbing green and blue-green light from λλ 4700 to 5400. If the section is photographed by green light of wave-lengths 5000 to 5400, completely absorbed by eosine, the section is entirely black, the maximum amount of contrast being obtained, and, owing to an excess of contrast, the detail of the section is blocked up. Photographing at λ 5700, on the border of an absorption band, a greatly lessened contrast is obtained, which for this particular section will give the best result. If we photograph by red light of wave-length 6400, which is completely transmitted by the section, the contrast disappears and the results are flat and useless.



Absorption Spectrum of Aniline Blue.

Transmission Spectrum of Wratten B and E Screens.

This section thus demonstrates the close connection between the colour of the illuminating light and the contrast produced. A different procedure is required if contrast is to be obtained, not against the background, but within the object itself.

A good case of this is the photography of an unstained section of whalebone; this is of a yellow colour, and shows ample detail to the eye, but it completely absorbs blue-violet light, and if it is photographed on an ordinary plate sensitive only to blue-violet light, then it shows far too much contrast, appearing as a black detailless mass against the background, and presenting an exaggerated example of the loss of detail which has already been noted in the eosine section photographed by light which it completely absorbs.

The proper procedure in this case is to photograph the object by the light which it transmits. The whalebone section, for instance, photographed by red light, gives perfectly satisfactory results, showing ample detail in structure.

The best method of determining the contrast required by any object is to examine the object visually under the microscope first by means of a combination of screens transmitting light absorbed as completely as possible, and then by other screens transmitting light less completely absorbed, until the degree of contrast obtained is satisfactory to the eye.

In the booklet on photomicrography, Messrs. Wratten and Wainwright, Ltd., publish a list of the chief microscopical stains, giving their absorption bands. By the help of a special set of screens a section stained with any of these colours can be illuminated in such a way as to produce any required degree of contrast.

The accompanying illustration shows the absorption spectrum of aniline blue, and the transmission band of the filters chosen to produce the maximum degree of contrast.

In order to estimate exposure, tables are given showing the various factors involved, and including a table giving the multiplying factors of the screens used singly and in pairs, the light sources given ranging from the oil lamp to the open arc.

PRIZE AWARDS OF THE PARIS ACADEMY OF SCIENCES.

AT the annual public meeting of the academy, held on December 19, the prizes awarded for the year 1910 were announced as follows:—

Geometry.—The grand prize of the mathematical sciences was not awarded, no memoir having been presented on the stated problem; Emile Lemoine receives the Francœur prize, and M. Riquier the Poncelet prize.

Mechanics.—A Montyon prize is awarded to Jules Gaultier, for his inventions in connection with surveying instruments; the Fourneyron prize was postponed to 1912.

Navigation.—The extraordinary navy prize was divided between G. Hilleret (3000 francs), J. L. H. Lafrogne (1500 francs), and J. Lecompte (1500 francs); the Plumey prize was not awarded.

Astronomy.—The Pierre Guzman prize was not awarded, but the interest accrued was attributed to the late Maurice Lœwy, for the whole of his scientific work; the Lalande prize to P. H. Cowell and A. Crommelin, for their researches in connection with Halley's comet; the Valz prize to Stéphane Javelle, for his work on nebulæ and periodic comets; the Janssen medal to W. W. Campbell, for his researches in stellar spectroscopy.

Geography.—The Tchihatchef prize is divided between Dr. Verbeek (2000 francs), for his geological explorations in Borneo, Sumatra, and Java, and Louis Vaillant, for his explorations in Central Asia; the Gay prize is not awarded, but Carlos Porter receives a mention for his work on the fauna and flora of Chili; the Binoux prize is divided between Emmanuel de Martonne (1000 francs), for his work in physical geography, A. Bellot (500 francs),

for his monograph on the island of Delos, and Crépin-Bourdier de Beauregard (500 francs), for his guide to the geographical explorer; the Delalande-Guérineau prize to the Marquis de Segonzac, for his work in Morocco.

Physics.—The Hébert prize is awarded to M. Barbillion for his works on the technical applications of electricity; the Hughes prize to Alexandre Dufour, for his researches in spectroscopy; the Kastner-Boursault prize to M. Magunna, for his inventions in connection with multiplex telegraphy; the Victor Raulin prize to Gabriel Guilbert, for his meteorological researches in connection with weather forecasts.

Chemistry.—The Jecker prize is divided equally between A. Guyot and J. Bougault, for their researches in organic chemistry; the Cahours prize between MM. Brunel, Guillemard, and Jolibois; a Montyon prize is awarded to M. Taffanel, for his researches on explosives used in mining, and a mention (1500 francs) is divided between his assistants, MM. Fenzy, Le Floch, and Durr; the Alhumbert prize to Witold Broniewski, for his experimental studies on the electrical properties of the metallic alloys.

Botany.—No award was made of the Desmazières prize; Georges Bainier receives the Montagne prize, for his studies of the moulds; Hippolyte Coste, the de Coincy prize, for his book on French flora; Maurice Bouly de Lesdain the de la Fons-Mélicocq prize, for his memoir on the lichens in the neighbourhood of Dunkerque; G. Chauveaud the Bordin prize, for his memoir on the development and disappearance of the transitory tissues of plants.

Anatomy and Zoology.—The Savigny prize is awarded to Emile Brumpt, for his studies of African parasitic diseases; the Thore prize to Emile Massonnat, for his entomological studies.

Medicine and Surgery.—Montyon prizes (2500 francs) were awarded to G. Martin, Lebœuf, and Roubaud, for their report on the expedition for the study of sleeping sickness in the French Congo; to J. Déjerine and André Thomas, for their book on diseases of the spinal column; and to E. Perroncito, for his researches on the causes of pernicious anæmia in miners. Mentions (1500 francs) were awarded to Ch. Mantoux, for his memoir on the intra-dermo reaction with tuberculin; to P. Emile Weill; for his researches on the treatment of subjects with non-coaguling blood; and to MM. Moussu and Monvoisin, for their memoir on the milk of tuberculous cows. MM. Aynaud, Léon Bérard, and Jules Milhit receive citations. The Barbier prize is divided between A. Thiroux, for his memoir on sleeping sickness and the animal trypanosomiases in Senegal, and H. Bierry, for his work in experimental physiology; the interest on the Bréant prize is divided between Jules Bordet (3500 francs), for his work on immunity and studies on the serum of vaccinated animals, toxins, and antitoxins, and A. Taurelli Salimbeni (1500 francs), for his work in connection with cholera; the Godard prize is awarded to L. Ambard and E. Papin, for their study on urinary concentrations, very honourable mentions being accorded to MM. Carle, Hans von Winiwarter, and G. Sainmont; the Baron Larrey prize is divided between M. Chavigny, for his studies in military psychiatry, and Miramond de Laroquette, for his memoir on the scapular ring; the Bellion prize is divided between M. Imbeaux, for his work entitled "Statistical and Descriptive Annual of the Distribution of Water" (in collaboration with MM. Hoc, Devos, van Lint, Peter, Bétant, and Klein), and MM. Frois and Sartory; the Mége prize is not awarded, the interest being divided between Mlle. J. Joteyko and Mlle. Stefanowska; Séverin Icard receives the Dusgate prize, for his memoir on the signs of real death in the absence of a doctor.

Physiology.—A Montyon prize is divided between Ch. Livon, for the whole of his work in experimental physiology, and Marin Molliard, for his memoirs on the organic nutrition of the higher plants in its relations with morphology; the Philipeaux prize is awarded to Maurice Arthus, for his work on anaphylaxy; the Martin-Damourette prize to E. Laguesse, for his researches on the structure of the pancreas and their application to a rational treatment of various forms of diabetes; the Lallemand prize is divided between René Legendre and Aldo Perroncito, the former for his contributions to the knowledge of the nerve cell, and the latter his researches on the regeneration of the nerve cell. No memoir having been received on the question suggested for the Pourat prize, this has not been awarded, and is postponed until 1913.

Statistics.—MM. de Chabert and Gallois receive a Montyon prize (1000 francs) for their general atlas of Indo-China, with statistical tables, mentions of 250 francs being accorded to MM. E. Blin and Perrier.

History of Science.—The Binoux prize is awarded to Ernest Lebon, for the whole of his historical work, and especially his history of astronomy.

General Prizes.—Berthelot medals are awarded to MM. Barbillion, A. Dufour, Magunna, Gabriel Guilbert, Guyot, J. Bougault, Guillemard, Taffanel, and Broniewski; the interest of the Lannelongue foundation is divided between Mme. Cusco and Mme. Rück; Charles Fremont receives the Trémont prize; Arthur Robert Hinks the interest on the Leconte prize (2500 francs), for his researches on the solar parallax; Fabry and Perot a Wilde prize (3000 francs), for their researches on new interference methods in spectroscopy; Harel de la Noë the Caméré prize, for his improvements in bridge construction. The Lonchampt prize is divided between Albert Frouin (2000 francs), for his work on the use of calcium and magnesium salts after of orchids, F. Monier, F. Chesney, and E. Roux (1000 francs), for his researches on the influence of mineral salts in the therapeutics of fractures, and M. Fleig (1000 francs), for his studies on the intravenous injection of mineral solutions; the Saintour prize between Noël Bernard (3000 francs), for his researches on the biology of orchids, F. Monier, F. Chesney, and E. Roux (1000 francs), for their book on adulteration, and E. Kayser (500 francs), for his work as a whole. The Jérome Ponti prize is given to Henri Andoyer, an encouragement of 500 francs being accorded to M. Kimpflin. The Houllevigue prize is awarded to the late Bernard Brunhes, and an additional prize from the same foundation to Emile Gérards. M. Audibert receives the prize founded by Mme. the Marquise de Laplace, and MM. Audibert and Henry Weill the prize founded by M. Félix Rivot.

The Bonaparte Fund.

Thirty-four applications for grants out of this fund were received by the committee for the year 1910; after reducing the number to eleven, the total amount required still exceeded the amount available. Under these conditions, Prince Roland Bonaparte placed an additional sum of 5000 francs, making 30,000 francs in all, for the current year, out of which the committee recommend the following grants:—

5000 francs to M. Hartmann, for the experimental study of the distribution and development of elastic forces in bodies deformed by external stresses.

5000 francs to M. Urbain, for the extraction on the large scale of germanium, indium, and gallium from blende.

3000 francs to MM. Bauer and Moulin, for the construction of an electric furnace in platinum or iridium, to be applied to the determination of Stefan's constant and the distribution of the energy in the spectrum.

2500 francs to M. Blaringhem, to enable him to continue his researches on hereditary variations in plants, to prepare a complete collection of the plants studied during the last four years, and to purchase a suitable microscope.

2500 francs to M. Nicolardot, to enable him to pursue his studies on columbium and tantalum, especially for the purchase of the necessary platinum vessels.

2000 francs to M. Jules Baillaud, to enable him to complete his researches on atmospheric absorption, the amount to be applied to the construction of a special photometer.

2000 francs to M. Chevalier, to enable him to carry on his studies on the vegetation of French tropical Africa.

2000 francs to M. Eberhardt, for the extension of his exploratory studies on the economic botany of French Indo-China, and to complete the installation of his laboratory at Hué.

2000 francs to M. Gaillot, for the completion of the

calculations necessary to the revision of Le Verrier's tables of Jupiter.

2000 francs to M. Bordmann, for the completion of his stellar photometer.

2000 francs to M. Quidor, for assistance in the publication of his memoir on the external morphology of the parasitic copepods.

SEX RELATIONSHIP.

PERHAPS one of the most subtle and interesting problems of life is the numerical relationship of sex and its influence on the body politic.

It has always been something of a puzzle why the proportion of each kind, apparently with little or no underlying reason, is produced in the right numbers. The argument that if such were not the case the particular species would not survive does not reveal to us the methods by which this object has been achieved by nature. That some mechanism must exist by means of which, within certain limits, the number of males and females born is regulated, is proved by the facts of history, where we have numerous examples of wars and other social upheavals where males have largely suffered, and yet within an apparently short period of time, as measured by such events, a balance has been again re-established. The sex equilibrium may be compared to that of a gyroscope, where the greater the disturbance of position the greater is the force tending to re-establish its natural stand whilst in motion. Nature in her methods never does anything exactly, but approaches an object by establishing lateral control, which guides her on her way, should any deviation occur. Thus she does not proceed along a straight line, but is continually oscillating to either side. Her progress may very well be likened to that of an inebriated person in search of his dwelling. All that can be said is that he has a tendency homewards.

The facts regulating sex must be something of the same type, and are such that the greater the oscillation in any one direction the greater must be the restraining force invoked to curb or neutralise the movement. All such movements have an inertia, and consequently, like a pendulum, pass the middle line and establish a negative phase. The history of any race in its sex composition would show us that such oscillations have occurred throughout time, modified, no doubt, in their regular sequence by such factors as wars and famine. These oscillations of sex balance have brought with them certain changes and movements in the people themselves; an excess of males would naturally tend to produce war, either civil or foreign, whilst a superfluity of females is easily associated with upheavals in the domestic polity of the community. There is no doubt that, could we trace the history of the world, or any section of it, we should see that man simply reacts to certain variations which are inevitable sequences in the establishment of this balance. Are there at present any indications of the methods upon which, or factors by which, this state is maintained? As is usually found, "truth is simple," and so the workings of nature, when once discovered, are easily understood. The sex constitution of our population, upon which such mighty issues depend, appears to obtain its regulating force from a very simple factor, and apparently is correlated with age only.

At the present time the sex balance is as follows:—At birth the ratio of males to females is about 1030 to 1000; at the fifth year, owing to deaths amongst the males, the balance is equal; from the fifth to the fifteenth year the mortality amongst the females is slightly higher than amongst the males, but from that time onwards the females relatively increase. If we take the male as a few years older than the female for the purpose of mating, then the balance is disturbed further still. The result of this is to produce in a community a section of women who cannot possibly perform that function for which they were fashioned. Their energies are naturally directed into other spheres, as evidence of which we see the revival of the movement for political recognition. The agitation is no new one, and apparently is dependent for its strength and virility on the position of the sex pendulum. If the present female oscillation has not yet reached its zenith the agitation will continue; if the reverse is happening, as there is reason to believe to be the case, then the present movement, after certain bursts of rejuvenescence, should slowly subside, to be again resurrected at some future epoch in the history of the world.

The following table gives the relationship of the age of the mother to the sex of the child:—

(*Taken from an Inquiry into Birth Conditions in the Town of Middlesbrough.*)

	Total number of births: Males	Females	Males born per 1000 females
All births up to 19th year	29	44	659
,, ,, 24th ,,	226	264	856
,, ,, 29th ,,	437	455	960
,, ,, 34th ,,	617	617	1000
,, ,, 39th ,,	720	715	1007
All births	772	750	1030
England and Wales (1910)	—	—	1033

If taken between the stated ages the figures are as follows:—

	Total number in each period: Males	Females	Males born per 1000 females in each period
Up to 19th year	29	44	659
From 20th to 24th year inclusive	197	220	895
,, 25th ,, 29th ,, ,,	211	191	1105
,, 30th ,, 34th ,, ,,	180	162	1111
34th year and over	155	133	1165

It is seen that, as a matter of fact, the tendency to produce females over males is present in young mothers; at more mature ages there is an excess of males. We can easily see how a self-regulating balance is established, depending upon this fact. In a state of society in which females are scarce they naturally, owing to demand, mate early in life, and tend thereby to reproduce an excess of their own kind (females), thus neutralising the state which recently existed. On the other hand, should the males be in the minority, the females will mate at more mature ages, at any rate at ages of twenty-five and above as is at present, in which circumstance an excess of males is produced. We see, therefore, that the natural tendency at the present time is to neutralise the female excess. We may possibly look upon ourselves at the present moment as being at the zenith of a female oscillation, and as time progresses, helped probably by a saving of infantile life, a more numerical equality of sex will be established.

The relationship of the age of the father to the sex of the child is much the same as the mother, and where disparity in age occurs the influences may neutralise each other, so that with a mother of about twenty years and a father of about thirty years the chance of a boy or a girl should be about as equal as nature can make such a problem. Education is attempting to teach the inhibition of self, and thus delaying the age of marriage, so that the preponderance of male births should go on increasing. If the present rate of progress is maintained, and allowing for the greater mortality of the male infant over the female, an average marriage rate of between twenty-seven and twenty-eight years should produce a population in which the males are at all periods in excess of the females.

R. J. EWART.

AVIATORS AND SQUALLS.

ON looking through the now formidable list of fatalities which mark the progress, and the dangers, of aviation, the reader is often struck by the number of accidents where the reason for the capsize of the machine is not apparent. "Holes in the air" is the explanation frequently tendered, but it seems more than probable that sudden gusts, or squalls, at critical moments may be the real factors causing the trouble. For this reason an article by M. Durand-Gréville in the December (1910) number of the *Bulletin de la Société astronomique de France* is of interest.

M. Durand-Gréville proposes a system of warnings of

grains and *coups de vent* which would inform the airman of the approach of grave risks should he attempt an ascent until the squall has passed. So far back as 1892 M. Durand-Gréville made the suggestion to meteorologists in a memoir entitled "Les Grains et les Orages," which appeared in the *Annales du Bureau central meteorologique de France*. This memoir showed that the isochronic lines marking the commencement of storms corresponded with much longer *isochrones* of squalls. The name *ruban de grain* was attached to a more or less sinuous band extending from near the centre to the circumference of a depression. This band is often 1000–1500 km. (625–940 miles) long, and in its interior the wind is very strong, and often accompanied by precipitation. The advent of the squall is generally marked by a gentle south-west wind veering with startling suddenness and violence to the north-west, masses of cloud come up rapidly from the west, and frequently heavy thunder is heard. All these phenomena occur suddenly and practically simultaneously, so that the passing of the squall is easily and definitely observed.

M. Durand-Gréville's proposal is that from those stations first passed over, telegraphic warnings should be immediately dispatched to centres lying eastwards in the subsequent path of the disturbance. Numerous experiments have demonstrated the feasibility and utility of the scheme. Stations west of Paris have sent messages announcing squalls which have subsequently passed over that city at the predicted time.

On the occasion of the great Aëronautical Congress at Frankfort during 1909, the plan was tried by M. Linke, director of the meteorological station there. Fifty-five observers within a radius of 150 km. were asked to notify the director of any squall which passed over their separate stations, and M. Durand-Gréville states that, "save in one or two cases, all the storms which visited Frankfort during this period were known to M. Linke *more than an hour in advance*."

M. Durand-Gréville points out that the expense to any body which undertook the organisation of the warnings would be almost negligible as compared with the money expended in prizes awarded to aviators, not to mention the much greater cost of machines, &c., and the lamentable sacrifice of human life which might, at least to some extent, be obviated. The ordinary forecasts and warnings issued by the various national meteorological offices are far too general to be of use in this regard, but special services might be instituted, as a trial, by some of the societies especially interested in aëronautical matters.

TEMPERATURE OF THE UPPER AIR.

M. M. RYKACHEF has worked out the results of balloon ascents at Pavlovsk, Kuchino near Moscow, and Nizhni Olchedaief. There were sixty-three flights at Pavlovsk, thirty-two at Kuchino, and twelve at Olchedaief, some of which attained a height of 12 kilometres. With regard to the yearly means, the temperature at Pavlovsk was up to 9 km. lower than at Kuchino, the differences increasing up to 3 to 3·5 km., and then diminishing. At 9 km. they change sign, increasing up to a maximum of about 4° C. between 10·5 and 12 km. The difference of temperature between Pavlovsk and Nizhni Olchedaief is much greater, diminishes up to 10 km., where it changes sign, and attains a maximum of 1° between 11 and 12 km. A marked diminution in the fall of temperature takes place at a lower height in Pavlovsk than in Kuchino, and at Kuchino than at Olchedaief, the heights being 9·5, 9·8, and 10·8 km. respectively. The temperature of the isothermic layers is highest at Pavlovsk and lowest at Kuchino. These variations may be explained by the differences of latitude, Pavlovsk being situated at about 60°, Kuchino 56°, and Nizhni Olchedaief 48°, while Pavlovsk is more exposed to the mild influence of a sea climate than the other two places.

At Nizhni Olchedaief the ascents were too few to deduce any satisfactory conclusions with regard to seasonal variations. At Pavlovsk the temperature at all seasons from the ground up to 8·5 to 9 km. was lower than at Kurchino, except that in winter the temperature up to 500 metres was higher, which result accords with the readings taken on the ground for a series of years. The difference of temperature in winter, spring, and autumn shows a marked increase at about 2·5 to 3 km., changes sign at 8·5 to 9 km., and rapidly increases to the isothermic layers, where the temperature is lower at Kuchino than at Pavlovsk. In summer the difference decreases continually up to 9·5 km., and then changes sign and increases. The height where the fall in the temperature becomes insignificant is lower in all seasons at Pavlovsk than at Kuchino, except in spring, when it is about 10 km. at both stations.

The temperature of the isothermal region is markedly lower at Kuchino. In the curve of monthly means is seen a retardation of the maximum in the higher layers of air. In the lower atmosphere the maximum occurs in July both at Pavlovsk and Kuchino, but at greater heights it occurs in August, the change taking place at a height of 2·5 km. at Kuchino and at 4·5 km. at Pavlovsk. At 9 km. the maximum returns to July. The minimum exhibits somewhat similar variations. Amplitudes and gradients, mean changes of temperature with elevation in cyclones and anticyclones, &c., are also discussed, with numerous tables and diagrams, in an article published in the Bulletin of the Imperial Academy of Sciences of St. Petersburg, No. 7, 1910.

THE INCENSE-ALTAR OF APHRODITE AT PAPHOS.

AN interesting article by Dr. Max Ohnefalsch-Richter appears in *Globus* of November 17 (xcviii., pp. 293–7), in which he brings forward data to prove his earlier supposition that the first site of Paphos was in the neighbourhood of Randi, in Cyprus. Certain inscriptions from this vicinity showed that Aphrodite, "the unconquerable," sender of Spring, was worshipped, and that an ancient incense-altar had existed there. The block containing the most important inscription is held by Prof. Richard Meister, of Leipzig, to belong to an incense-altar, and he adds that the incense-altar of Aphrodite at Paphos (Homer, VIII., 362; Homeric Hymns, IV., 59) was famous from earliest times.

Last August Dr. Ohnefalsch-Richter was able to identify a semi-subterranean side-chamber in the rock connected with this altar, whence had come the inscribed incense-bowls which Prof. Meister has been deciphering. Dr. Zahn's excavations in the chamber have brought to light some half-dozen further inscriptions in the Paphian script, and he has made a number of valuable discoveries on the hill-side below, among them phalli which again played an important part in the Paphian Aphrodite-worship. The cult carried on on the hill consisted in making incense offerings, as described by Homer; in Dr. Zahn's opinion images were not used originally. A clay statue of about life-size was, however, found in the middle of the altar-chamber, the style indicating a date about 600 B.C. The article concludes:—"We must wait to see what Prof. Meister will make of the hundred and more inscriptions discovered. As yet everything supports my surmise that on the hill of the incense-altar at Randi, not only *an* incense-altar of Aphrodite Paphia stood, but *the* most famous, the Homeric, incense-altar of Aphrodite of Paphos."

Early in the article the writer refers to ten inscribed stones from Randi "from secret, prohibited excavations," which were fortunately purchased by someone who generously presented them to the Cyprus Museum. This is additional evidence, if such be required, of the urgent necessity for strong measures by the Government for the repression of illicit traffic in objects of archæological interest in this island and elsewhere.

A. C. H.

AIMS OF ASTRONOMY OF PRECISION.[1]

THE science of precise physical measurement is one which does not readily appeal to those not immediately concerned, either with the methods or results. An authoritative statement that the sun's distance from the earth is 92,880,000 miles may excite wonder, but scarcely more than will the statement that it is approximately

[1] From the presidential address delivered before the Royal Society of South Africa on April 20, 1910, by S. S. Hough, F.R.S. Published in the Transactions of the Society, vol. ii., part i.

93,000,000, except in the minds of those who are in some measure acquainted with the laborious processes by which the two extra figures are derived. In fact, I have not infrequently heard the methods of observation used described by some such epithet as "hair-splitting." For this reason I think I cannot do better to-night than to describe to you, without entering into technical details of the methods employed, some of the aims and objects to which modern astronomy of precision is devoted, and which render essential none but the highest refinements that human ingenuity can devise.

Perhaps the primary reason why astronomy appeals to the popular imagination in a higher degree than other sciences is that astronomy is *par excellence* the science of prediction. True, the days are now past when an astronomer is regarded, except by the most ignorant, as gifted with supernatural powers and capable of predicting events that can have no conceivable relationship with the objects of his researches, or when an unscrupulous astronomer could utilise his powers of prediction for imposing on the world at large in the face of the criticisms of fellow-workers in collateral branches of science. Nevertheless, it is only necessary to point to any of the leading almanacs to establish the undoubted claim of astronomy to a considerable predictive capacity in its own legitimate sphere. These almanacs, prepared in advance, give from day to day the positions of the sun and moon, the phenomena of eclipses, and various other data with an accuracy which can only be called in question by the most refined tests available to astronomers.

How, then, has astronomy acquired this faculty? The answer to this question is—at least primarily—by continuous and patient observation, using always the most refined methods of physical measurement available.

A well-devised scheme of observation is sooner or later bound to lead to the detection of laws governing physical phenomena if such laws exist. Thus it was the planetary observations of Tycho Brahe which led to the detection of the laws of planetary motion associated with the name of Kepler.

Once such laws have been established and the necessary initial data secured, the science of astronomical prediction would for the future devolve on the mathematician rather than the astronomer, were it not for two sources of uncertainty with which the astronomer must continue to concern himself. It is evident, on one hand, that we cannot infuse into our predicted phenomena greater precision than that derived from the initial data, themselves dependent on imperfect observations. However well the laws governing planetary motions may be understood, the predicted position of a planet to-day depends on its observed positions at some earlier epoch or epochs; and the fallibility of the observations made at these earlier epochs will not only pervade all future predictions, but will inevitably increase in amount as the epoch of prediction recedes from the epoch of observation. For this reason, if the standard of accuracy of prediction is merely to be maintained—and the growing requirements of science will scarcely rest contented with this—continuous observation must be maintained and the data on which predictions are based revised from time to time.

I have dealt so far only with the effects of the unavoidable inaccuracies of observations, even when pushed to their utmost refinement, as influencing results of prediction. A second consideration of even greater importance is the validity of the laws associating the predicted with the observed phenomena. I may illustrate my point again by reference to the laws of Kepler. It is now well known that these laws are only rough approximations to the actual truth, and that though they might serve as a useful basis for prediction over a short interval, a few years at most would suffice, by showing a rapidly increasing departure between the observed and predicted positions of the planets, to indicate that these laws require amendment.

That the direction this amendment should take followed so soon on the original discovery of Kepler's laws was due to the genius of Newton, who showed that the theory of universal gravitation propounded by him not only adequately accounted for the laws enunciated by Kepler, and pointed to their imperfections, but served to coordinate as due to a single cause even more recondite phenomena, such as the leading inequalities in the motion of the moon, the precessional motion of the earth, and the phenomena of the tides. This theory further reduced to order those astronomical vagaries the comets, showing that, so long at least as they remained within the precincts of the solar system, their motions were governed by it, while observations of double stars have established beyond question that even remote parts of the universe are still subject to the same laws.

The dynamical laws propounded by Newton, which to-day virtually form the basis of all astronomical prediction, enable us to trace back as well as to trace forward the history of the solar system, and to confront modern observations with historical records. Needless to say, in but rare instances do these records possess the necessary elements of precision to strengthen the existing data required by the astronomer; but there are important exceptions. For instance, a very small uncertainty in the "elements," which in conjunction with Newton's laws govern the motion of the moon, will produce by lapse of time a large change in the comparatively small area of the earth's surface over which a total eclipse of the sun is visible as such. Thus a record that a particular eclipse was seen as total in a given locality becomes an observation of precision, provided only the chronological date at which the eclipse occurred can be traced with sufficient certainty to ensure the identification of the eclipse concerned.

The confrontation of modern with historical observations of such a character has served to establish beyond question the high degree of accuracy with which the laws of Newton represent the motions within the solar system, and their trustworthiness as a basis of prediction for years, perhaps for centuries, to come. It is, however, on various grounds quite certain that these laws in themselves are not absolute, far-reaching though they are, and that they in turn, like those of Kepler, must be superseded by laws still more exact.

Until such laws are discovered there will always remain an element of uncertainty, apart from that due to the initial data affecting all predicted phenomena—an uncertainty which can only be removed when the phenomena cease to be prospective, and when they can be confronted with later as well as with earlier observations.

The fact, however, that the laws of gravitation yield such a close representation of the observed motions within the solar system throughout historic time renders the detection of a departure from these laws a question of extreme delicacy, but none the less essential, if prediction is to be secured for long periods in advance.

I have selected my illustrations largely from the solar system chiefly on the grounds that, thanks to the Newtonian laws, it is here that, in spite of the immense mathematical difficulties which have had to be faced, astronomical prediction has attained its greatest triumphs. I wish now to divert attention to the stars. In so far as these form the fiducial points to which the motions of the planets and other members of the solar system are referred, it is essential that the positions of a limited number, at least, should be determined with the highest possible accuracy. Any uncertainty in their positions will undoubtedly be reflected in the positions of the planets, and will constitute one of those sources of error so liable to increase with time, and render efforts at prediction, if not entirely nugatory, at least partially ineffective.

The universe of so-called "fixed stars" is not invariable in aspect, though its changes, for the most part, are of so minute a character that they can only be surely detected either by the most delicate measurements or by their cumulative effect over long intervals of time. It is chiefly through a study of these changes that our knowledge of the stellar universe has been acquired in the past, and it is largely to similar means that we look for an extension of this knowledge.

Among changes which lend themselves to observation for this purpose we may enumerate:—

(1) Changes of the intensity of the light of the stars. The origin of these changes, except in a few instances, remains obscure. In certain cases, however, notably in the case of variable stars of the Algol type, a satisfactory explanation of the observed phenomena has been found in the motions of a system, governed by laws similar to those

operating in our solar system, of which the visible star forms a constituent member.

(2) Changes of position due to orbital motion in binary or multiple stars. Where both components of a binary star are visible, these changes readily admit of direct measurement. In other cases the existence of a companion is inferred to account for regular periodic changes of position of the visible component, though this companion cannot be seen either on account of intrinsic want of light or on account of its close proximity to the primary, and the consequent incapacity of our telescope to render the two visually distinct.

These changes are of interest as affording evidence of the validity of the Newtonian laws in systems other than the solar system.

The changes to which I have so far referred are changes which affect isolated stars or groups of stars, but which do not occur, at least to a sensible extent, in the generality of stars.

I come now to the changes of position due to the earth's orbital motion which, on the other hand, may be expected to influence all stars in common. Even where, as in the cases I have already spoken of, their influence is obscured by orbital motion within the system, when once this orbital motion has been thoroughly examined, its laws deduced, and due allowance made for it by computation, we might expect to find the effects of the earth's motion still apparent.

The earth in its orbit round the sun approximately describes a circle of 186,000,000 miles in diameter, and its successive positions in space at intervals of six months are separated from one another by this extent. But experience has shown that recurring changes in the relative positions of the stars, as viewed at intervals of six months—that is to say, from two different points of the universe separated by this vast distance—can only be detected in the case of a limited number of stars, and then only by the application of the most delicate methods of measurement specially designed to bring these changes to light.

To the Cape Observatory and its former director, Henderson (1832–4), belongs the credit of first producing trustworthy evidence of the existence of any fixed star, for which these changes could be unmistakably detected, and which, therefore, was not too remote from the solar system to permit of its distance being at least roughly determined in comparison with the diameter of the earth's orbit. Henderson's discovery has since been fully confirmed by later observers, and other stars likely to yield tangible results have now been examined. As illustrative, however, of the evasiveness of the quantities sought, and the excessive labour by which only they can be derived, though the problem of stellar distance has always been in the forefront of astronomical interest, and has attracted the attention of several able observers, the number of stars for which well-determined parallaxes have been published up to the present day does not exceed some 400. This number is quite insignificant in comparison even with the number of stars visible to the naked eye without telescopic aid. Moreover, the stars investigated have been, in general, selected on the grounds of some *a priori* probability of their possessing a measurable parallax, either on account of apparent brightness or on account of their large apparent motion, and for this reason they can scarcely be regarded as typical of the generality of stars.

In order, then, to gauge the depths of the visible universe it would appear imperative that our base-line must in some manner be extended. The distance of 186,000,000 miles through which we are carried in the course of a single half-year by the orbital motion of our planet round the sun is so small in comparison with interstellar distances as to give rise to changes in the apparent relative positions of stars which, except in the most pronounced instances, are so insignificant in amount as to defy detection even by the most refined processes of measurement we possess.

How, then, can such an extension of our base-line be attained? I have already pointed out that the so-called "fixed stars" are not truly "fixed," but that on close observation it is found that each star has an apparent motion either peculiar to itself or shared by other neighbouring stars which, with it, constitute an independent system. I refer primarily to the visible motion transverse to the line of sight.

If then our sun, as we may reasonably suppose, is itself a member of the stellar universe, it may be anticipated that it too will not be at rest, but will be moving forward in space, and the visible motions will be those due to the combined effects of the motion of the sun and stars.

That the apparent motions of the stars were not entirely fortuitous, but that they could, at least partially, be coordinated throughout the sky as the visible manifestations of a single phenomenon, viz. a translatory motion of the sun with its system of planets through interstellar space, was first pointed out by Sir William Herschel, who further indicated that the point of space to which this motion was directed was situated in the constellation "Hercules."

Before proceeding to the further consideration of this solar motion, I wish first to point out to you how its existence at once suggests a means of "extending our base-line" for the purpose of gauging these interstellar depths. I have refrained from any numerical estimates of the amount of this motion, as this involves philosophical questions into which I do not desire to enter to-night; but in order to fix our ideas it is necessary for me to give you some notion, at least, of the order of magnitude. It is now possible to state with some certainty that the speed of the sun's motion relatively to the stars as a whole amounts to about 20 kilometres per second, and that the space traversed in a single day therefore amounts to rather more than 1,000,000 miles, that in a year to about 400,000,000 miles. Thus the stars, as seen on two occasions a year apart, may be considered as viewed from two points in space separated by this length, and it only requires lapse of time in order to increase the length to an almost indefinite extent.

The great scheme for the photographic mapping of the heavens at present being carried out on an extensive scale by means of the cooperative efforts of the leading observatories of the world will shortly furnish a highly accurate delineation of the skies as seen at the commencement of the twentieth century. This alone has called for concentrated effort extending over some twelve years at least, while it would even now scarcely be safe to say that another ten years will see its completion. An immediate repetition is scarcely to be contemplated, though a subsequent repetition at some future epoch, which may be agreed on by astronomers, forms an essential part of the programme as originally introduced.

When this scheme is completed in its entirety very ample data will be available for the discussion of stellar distribution by the methods I have suggested to you.

In the meantime, however, in such tentative attempts as have been made to fathom the secrets of the universe by means of the study of stellar proper motion, it has been necessary to rely on early recorded exact observations. It will be clear from what I have already explained to you that it is the earliest trustworthy records in comparison with the most up-to-date available which will yield the greatest length of base-line, and consequently the most trustworthy results. For this reason the majority of the discussions hitherto attempted have been based on the catalogue of Bradley, dependent on observations made by him at Greenwich between the years 1750–62. This catalogue contains the places of some 3000 stars observed with a precision far surpassing any similar previous observations, and comparing favourably with the best modern catalogues. The stars selected by Bradley are fairly uniformly distributed over the portions of the sky accessible to him, viz. from the North Pole to 30° south of the equator.

Unfortunately no early catalogue of stars of even approximately similar precision exists for the remaining region of the sky between 30° S. dec. and the South Pole, and the absence of exact knowledge of these regions for the earlier epochs has always hampered these discussions.

The discussions I refer to have generally had as their immediate objective:—

(1) The determination of the precessional constant, *i.e.* the annual amount by which the earth's axis of rotation changes its position in space, and

(2) The determination of the speed of the solar motion and the position of the solar apex, *i.e.* the point in the heavens towards which the sun's motion is directed.

The discrepancies in these quantities found by different investigators, either starting with different data or utilising different methods for the combination and discussion of the same material, had long been a puzzle to astronomers. The key to the situation was at length furnished by Prof. Kapteyn, of Groningen, who, in an epoch-making paper read before the British Association in Cape Town, first pointed out that the apparent motions of the stars indicated, not merely the existence of a single solar apex, but that there were two separate regions of the sky towards which a preference was shown by the directions of motion of the Bradley stars.

This was a phenomenon which could not be explained by a simple motion of translation of the sun, as evidently the sun's motion could not be directed to two different points simultaneously, and the only feasible explanation was that the stars consisted of two groups, and that the motion of the sun relatively to one of these groups differed from its motion relatively to the other, or that, though the stars appeared intermingled in space, they possessed an independent relative motion, which might be regarded as located in one group or in the other, but which was shared by all the stars peculiar to the group.

The theory of the existence of two streams or drifts of stars thus put forward by Kapteyn has since received full confirmation by other investigators, notably by Eddington, who based his examination on the early observations of Groombridge, and by Dyson, who limited his discussion to a selected list of stars possessing considerable proper motions.

Recent investigations at the Cape have led us to examine in somewhat more minute detail the proper motions of the Bradley stars, with the result that, though the phenomena first noticed by Kapteyn stand out as the most prominent feature, certain subsidiary features of no less importance have been brought to light.

I have concerned myself hitherto only with the visible motions of the stars transverse to the line of sight, as derived by the older methods of measurement. The introduction of the spectroscope into astronomical research has opened up vast new fields into which, so far as they relate to the chemical and physical constitution of the sun and stars, it is not my purpose to enter to-night. What I wish rather to emphasise is the value of this instrument as a supplement to the older methods in relation to the geometrical astronomy of position.

In accordance with the principle laid down by Doppler, the wave-length of light received from a source which is either receding from or approaching a receiver will appear to be modified by an amount dependent in a known manner on the velocity of approach or recession. If the receiver takes the form of a spectroscope which permits by any means, direct or indirect, of the measurement of the wave-lengths, and the normal wave-lengths of the lines under examination are independently determined by laboratory investigations, the difference between the observed and the normal wave-lengths will thus afford a means of measuring the velocity of approach or recession of the source of light.

Of the precautions necessary to ensure precision it is not my purpose to speak to-night. The large spectroscope of the Cape Observatory, which we owe to the munificence of the late Mr. Frank McClean, was from the outset constructed with due regard to these precautions, so far as they could be foreseen, for the purpose of determining with the greatest accuracy attainable the radial velocities of stars. The instrument has been already successfully used, and its capabilities have been established in an investigation of the aberration constant of light as depending on the apparent variations in the radial velocities of stars resulting from the earth's orbital motion.

From a relatively short series of observations discussed by my colleague Dr. Halm, this constant has been derived with a precision not inferior to that attained by the best series of older observations, and the capabilities of the method are yet far from exhausted.

At the present time the instrument is being devoted to a series of observations of all such stars as are accessible in the southern skies, the spectra of which present sufficiently pronounced features to admit of measurement, primarily with the view of ascertaining what evidence can be derived from a study of the radial velocities in regard to the systematic structure of the universe.

A year or two must elapse before the present observing programme is completed, but a preliminary discussion of the observations already secured in combination with the published results derived from similar observations in the northern hemisphere has revealed the existence of anomalies similar to those found from the study of the transverse motions—anomalies which can only be reconciled with the two-drift hypothesis put forward by Kapteyn by the further hypothesis that though both drifts pervade the whole sky, they are not similarly distributed throughout it.

At present, through scantiness of material, from a study of the radial velocities we have been able to do little more than discriminate between the two halves of the sky, which contain, respectively, the greatest and the least proportion of second drift stars. It is, however, a fact of some significance that the former corresponds very closely with that hemisphere which contains the Milky Way, suggesting the phenomenon that Kapteyn's second drift might be identified with the galaxy. It was with the view of examining this suggestion in the light of the evidence which could be secured from the transverse motions of the Bradley stars that the discussions I have sketched to you to-night were undertaken by Dr. Halm.

While they have established almost beyond question the rough features of distribution demanded to reconcile the radial-velocity determinations, they further point to an even more detailed correspondence between the distribution of galactic stars and the distribution of stars of the second drift, leaving but little doubt as to the identity of this second drift with the galaxy. It is this second drift which exhibits evidence of structural unity. As regards the Milky Way, the mere appearance on any fine night affords evidence of a similar character, and it is on this account that we have been able to identify the Milky Way with the second drift rather than with the first.

The significance and origin of this structure are as yet obscure, but the more its details are elucidated and the essential features established the nearer are we to an answer to the question, What is the Milky Way?

To revert to my original text, I have endeavoured to point out to you the methods of research by which an answer is sought to this and similar questions, and to explain to you the reasons why the highest precision attainable is a *sine quâ non* in the conduct of such research. Thus it is that the study of the large-scale phenomena of the universe resolves itself frequently into a study of the minute detail of instrumental appliances, on which must be brought to bear all the knowledge that can be derived from other branches of scientific work. The geologist helps us in the selection of stable foundations on which the engineer may erect our large instruments. Chemistry and physics in our photography, our optical and electrical appliances, are of daily application, while one of the most valued accessories in almost all methods of precise measurement is the spider's web we derive from zoology.

Astronomy, in its turn, has done much in the past, and in the future will doubtless do more, to assist the development of collateral sciences. Thus the geologist cannot afford to ignore, even if he does not accept as conclusive, the evidence furnished by astronomy as to the nature of the earth's crust. Exact measurements of space and time as conducted in physical laboratories are for the most part conducted by methods first designed to suit the requirements of astronomical precision, while in the sun and stars chemical phenomena, which may be studied with the aid of the spectroscope, are taking place on a scale far surpassing anything that can be produced in the laboratory.

The value of free intercourse between workers in the various branches of science is certainly indisputable, and I wish to close my address by reference to the opportunities which our society can afford in this respect. Devotees even of applied, and still more of pure, science in a young country are necessarily few in number and scattered. A large proportion of these will in the early stages of their career have been in close association with one or the other great centres of scientific activity of the world, and to such a feeling of scientific isolation almost amounting to

exile, and consequent lack of stimulus, is almost inevitable. Important as are our publications, it is even more through our monthly meetings and the promotion of personal intercourse that the society can help in its primary duty of the advancement of natural knowledge in South Africa.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE discussions at a conference of teachers in rural schools, held in London on December 28, 1910, under the auspices of the National Union of Teachers, showed that teachers are recognising more fully the desirability of making the education in elementary schools in country districts so far as possible of a practical kind, which will train the children for agricultural and other country avocations in later life. A resolution was adopted unanimously urging that, wherever possible, some teaching in handicraft and housecraft should be given to children in rural schools, and that, where necessary and practicable, centres for instruction in these subjects should be formed. It was suggested during the discussion that central school farms might be established, where practical work on the land could be carried on by boys drafted from neighbouring schools. It was recognised, also, that actual work in a garden abounds in opportunities for the best lessons in observation, attention to detail, never putting off until to-morrow what ought to be done to-day, as well as the cultivation of the virtues more commonly associated with the moral instruction lesson. Another resolution, unanimously carried, deplored the continuance of the partial exemption system, and declared that the time has arrived when no child shall be either partially or totally exempt from attendance at school before fourteen years of age. A discussion on continuation schools in rural districts revealed some diversity of opinion, but the meeting eventually decided that, having regard to the impossibility of satisfactorily organising and coordinating continuation work in rural districts, where children are at present allowed to secure partial exemption from school attendance at the early age of eleven or twelve for the purpose of employment, no exemption, either partial or whole-time, from day-school attendance should be granted until the age of fourteen years is attained, all wage-earning child labour out of school hours under the age of fourteen should be forbidden by law, and these conditions having been secured, a system of compulsory attendance at continuation schools or other suitable educational institutions from the age of fourteen to eighteen, accompanied by provisions which should safeguard young people against undue physical or mental overstrain, should be an integral part of a national system of education.

SOCIETIES AND ACADEMIES.

DUBLIN.

Royal Dublin Society, December 20, 1910.—Mr. R. Lloyd Praeger in the chair.—Dr. J. H. **Pollok**: The vacuum-tube spectra of the vapours of some metals and metallic chlorides (part i.). By the use of a new form of vacuum tube, made entirely of quartz, which the author has recently devised, he can readily obtain photographs of the whole of the vacuum-tube spectra of the vapours of metals and metallic chlorides. In the present paper the author gives a description of the quartz vacuum tube and photographs of the spectra of the vapours of mercury, zinc, cadmium, arsenic, and antimony, together with photographs of the spectra of their chlorides, under varying conditions. The vapours of the metals and their compounds, so far examined, show substantially the same line spectrum in the vacuum tube that they do when metallic electrodes are sparked in air. When a condenser is introduced in the circuit, the metal and its compound show precisely the same change of spectrum, which would seem to indicate that the changes take place in the vibrating atom. If a large amount of vapour of the chloride is present without a condenser, bands are seen in addition to the line spectrum of the metal, and these appear to be due to the particular compound present, and must therefore be connected with the vibrations of the molecule.—Dr. G. H. **Pethybridge**: Considerations and experiments on the infection of potato plants with the blight-fungus (*Phytophthora infestans*) by means of mycelium derived direct from the planted tubers. The theory recently advocated by Massee, that the potato crop becomes attacked with the "blight," not by means of the "spores" of *P. infestans*, but by means of the mycelium of this fungus, which, after lying dormant for a long period, passes from the planted tubers into the nearly full-grown stalks, is criticised, and it is pointed out how difficult it is to reconcile this mode of infection with the well-known facts of the disease. It is shown that, owing to the absence of controls, the experimental evidence on which the theory is based is quite worthless. A repetition of the experiments, carried out by the author with the necessary controls, gave results exactly the opposite to those on which the theory is based.—Rev. H. C. **Browne**: Some suggested improvement in epicyclic variable gears. The improvement applies specially to the modern bicycle, and consists in effecting the complete separation of the epicyclic train from all the moving parts on the middle speed, so that the friction is reduced to the same amount as if the machine were a single-geared machine, *i.e.* so that there is no movement except that of the ball races at each end of the axle. The high and low speeds are also improved by getting rid of all friction due to over-running pawls or the unnecessary rubbing of parts. The middle speed is produced directly by the engagement of the driving member with the hub, the epicyclic train being completely detached and in no contact with any of the moving parts. The linking up of the gear train with the drive for the high and low speeds is effected in a simple manner by the use of spring trigger pawls. Some care has been given to the construction of the epicyclic train so that it may be a proper mechanical unit in itself instead of being a somewhat loose assemblage of wheels. With this object, the wheels of the train are provided with friction discs reaching to the pitch lines, and the friction between the elements of the train is thereby reduced to rolling friction.

PARIS.

Academy of Sciences, December 27, 1910.—M. Émile Picard in the chair.—A. **Gaillot**: The analytical theory and tables of motion of Jupiter, by Le Verrier. Additions and rectifications. These tables represent with sufficient exactitude the observations made between 1750 and 1869. From 1870, the comparison of the observed and calculated positions shows increasing discrepancies. The tables for Jupiter have now been recalculated, and the results compared with observations for the period 1750 to 1906–7.—Paul **Sabatier**: A method for causing two substances to react in the electric arc. The method described by M. Salmon in a recent note (December 5) was anticipated by the author in 1899.—W. **Kilian** and M. **Gignoux**: An attempt to coordinate the levels of the pebble beds and terraces of the Bas-Dauphiné.—The perpetual secretary announced the death of Armand Sabatier, correspondant for the section of anatomy and zoology.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the third quarter of 1910. Observations were possible on sixty-four days during the quarter. Three tables of the results are given, showing number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Maurice **Servant**: The transformations of surfaces applicable to surfaces of the second degree.—T. **Lalesco**: Left-handed symmetrical nuclei.—G. **Kowalewski**: The formulæ of Frenet in functional space.—L. **Zoretti**: The equations of motion of a viscous fluid.—G. **de Proszynski**: The application of the gyroscope and of compressed air to taking kinematographic views. The gyroscope is driven by compressed air, and is attached to the camera in such a manner as to suppress or deaden small vibrations.—Jean **Becquerel**: The positive magneto-optic effect presented by the phosphorescence bands of rubies and emeralds, and the relations between emission and absorption in a magnetic field.—J. **Thovert**: Photometry and the utilisation of coloured sources of light. A description of a new empirical spectrophotometric method.—Daniel **Berthelot** and Henry **Gaudechon**: The principal types of photolysis of organic compounds by the ultra-violet rays. The photolysis of

primary alcohols is characterised by the predominance of hydrogen and absence of carbon dioxide; with secondary and tertiary alcohols the proportion of hydrogen is reduced, being replaced by methane and its homologues. Aldehydes give a gas containing carbon monoxide as the chief constituent, whilst carbon dioxide predominates for the fatty acids.—M. **Nanty**: The equilibria between potassium bicarbonate and hydrated magnesium carbonate.—Georges **Denigès**: A new reaction for cupreine. The reagent used is a mixture of water, copper sulphate, ammonia, and hydrogen peroxide. Cupreine gives a deep emerald-green coloration after adding some alcohol.—M. **Hanriot**: Brown gold. This name is applied to the gold left after treating a gold-silver alloy (20 per cent. gold) with nitric acid. This is not pure gold, but contains traces of silver, copper and lead, and also of nitric acid, even although the washings with water are free from acid. This gold undergoes changes in colour and volume on heating, a description of these being given in detail.—F. **Bodroux**: The action of some esters on the monosodium derivative of benzyl cyanide. In a preceding paper it has been shown that the sodium derivative $C_6H_5.CH.Na.CN$ reacts with the esters of the fatty acids, giving compounds of the type $C_6H_5.CH.(CN).CO.R$, and in the present note the reaction is extended to esters of the monobasic aromatic acids.—M. **Lespieau**: The condensation of acrolein bromide with malonic acid. The saturated acid $CH_2Br.(CHBr)_2.CH_2.CO_2H$ is obtained instead of the unsaturated acid expected.—L. **Tchougaeff** and E. **Serbin**: The complex salts of certain amino-acids. An account of the preparation and properties of some chromium salts of glycine and its homologues.—P. **Pierron**: A method of preparation of the aromatic acylguanidines.—L. H. **Philippe**: The glucodeconic acids.—Pierre **Breteau**: The addition of hydrogen in presence of palladium: application to phenanthrene. Palladium was used in the form of sponge, block, and precipitated metal, phenanthrene tetrahydride being formed.—MM. **Achalme** and **Bresson**: A method for determining the presence of one or several diastases in a liquid.—W. **Vernadsky** and Mlle. E. **Révoutsky**: The chemical distinction between orthose and microcline. Lithium and rubidium have been found in various microclines; this is opposed to the rule for distinguishing orthose from microcline, based on the absence of lithium and rubidium in the latter.—Auguste **Chevalier**: New evidence on *Voandzeia Poissoni*.—L. **Matruchot**: The new culture of an edible mushroom, *Pleurotus cornucopioides*.—G. **André**: The conservation of saline matters during the growth of an annual plant.—Henri **Agulhon**: The acquirement by maize of immunity with respect to boron compounds.—P. **Mazé**: Induced ripening of seeds. The antigerminative action of acetaldehyde.—P. A. **Dangeard**: The action of light upon chlorophyll.—P. **Ammann**: The existence of a perennial rice in Senegal.—P. **Bouin** and P. **Ancel**: The lipoid nature of an active substance secreted by the yellow body in mammals.—Louis **Lapicque**: The relation of the encephalic weight to the retinal surface in some orders of mammals. A new set of experimental results confirming the views announced in a previous paper.—C. **Houard**: The mode of action of Asterolecanium, external parasites of stems.—Auguste **Michel**: The structure of the elytra of *Halosydna gelatinosa*.—Fabre **Domergue** and R. **Legendre**: A method of detecting *Bacterium coli* in anaërobic cultures in waters and oysters. The development is carried out in the absence of air; this modification of the usual methods removes some ambiguities from the reaction.—E. **Doumer**: Epilepsy and constipation. Cases are cited in which the epilepsy was directly connected with constipation; electrical treatment of the abdomen, resulting in the removal of the constipation, completely suppressed the attacks of epilepsy.—M. **Godfroy**: Some results of the study of the Antarctic tides observed in the course of the French expedition to the South Pole. The results of the analysis of the observed data are not in accord with the views of Whewell or the more recent hypothesis of R. A. Harris, and show that the tides in this region are very complex.—Georges **Hervé**: The instructions given by the National Institute (first and second class) to Captain Baudin for his voyage of discovery in the Antarctic (1800–4).

DIARY OF SOCIETIES.

THURSDAY, JANUARY 5.

RÖNTGEN SOCIETY, at 8.15.—The Radioactivity of Thorium: Prof. Rutherford.

FRIDAY, JANUARY 6.

GEOLOGISTS' ASSOCIATION, at 8.—A History of Species-making; as illustrated by some Carboniferous Corals: by Dr. A. Wilmore.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Measurement of Boiler Deformations: G. F. Davidson.

TUESDAY, JANUARY 10.

INSTITUTION OF CIVIL ENGINEERS, at 8.—(1) The Strengthening of the Roof of New Street Station, Birmingham; (2) The Reconstruction and Widening of Arpley Bridge, Warrington: W. Dawson.

WEDNESDAY, JANUARY 11.

GEOLOGICAL SOCIETY, at 8.—The Zonal Classification of the Salopian Rocks of Cautley and Ravenstonedale: Miss G. R. Watney and Miss E. G. Welch.—On a Collection of Insect-remains from the South Wales Coalfield: H. Botton.

THURSDAY, JANUARY 12.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Absolute Expansion of Mercury: Prof. H. L. Callendar, F.R.S., and H. Moss.—The Density of Niton (Radium Emanations) and the Disintegration Theory: Dr. R. W. Gray and Sir W. Ramsay, K.C.B., F.R.S.—The Charges on Ions in Gases, and some Effects that Influence the Motion of Negative Ions: Prof. J. S. Townsend, F.R.S.—The Distribution of Electric Force in the Crookes Dark Space: F. W. Aston.—The Measurement of End Standards of Length: Dr. P. E. Shaw.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Adjourned discussion*: Submarine Cables for Long Distance Telephone Circuits: Major W. A. J. O'Meara, C.M.G.

MATHEMATICAL SOCIETY, at 5.30.—A Property of the Number 7: T. C. Lewis.—A Mode of Representation of an Electromagnetic Field as due to Singularities Distributed over a Surface: Prof. H. M. Macdonald.—On the Fundamental Theorem in the Theory of Functions of a Complex Variable: Dr. W. H. Young.

FRIDAY, JANUARY 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.

CONTENTS.

THURSDAY, JANUARY 12, 1911.

MIGRATORY BIRDS.

The Book of Migratory Birds, met with on Holy Island and the Northumbrian Coast, to which is added descriptive Accounts of Wild Fowling on the Mud Flats, with Notes on the General Natural History of this District. By W. Halliday. Pp. 258. (London: J. Ouseley, Ltd., n.d.) Price 5s. net.

THE obtrusive title of a work should, we think, be more closely descriptive of its contents than that of the volume now before us. "The Book of Migratory Birds"—the title conspicuously appearing on its cover—excites hopes in the ornithologist of a comprehensive contribution to a branch of his science of unquestioned interest. His momentary disappointment, on discovering from the continuation of the title inside, the restriction of its scope to the Northumbrian coast, may perhaps be relieved on his recalling the fact that the district, with its offshore islands and lighthouses, forms a migration-observatory from which a keen and persistent watcher might be expected to make valuable contributions to the question. His annoyance, however, will be acute when, on dipping into its pages, he finds the volume to be only a *mélange* of articles, strung together in the most casual way, and evidently originally contributed to some newspaper or journal in which either science was not a strong point or the editorial supervision was far from exacting.

The first part consists of a score of essays, not one without need of vigorous revision by a competent zoologist, while the second describes a certain number of the species of the Northumbrian coast individually; the book, however, makes no serious contribution to migration data, nor adds anything new to the history of the species observed. The first thirty-seven pages are alone specially devoted to the bird-life of Lindisfarne and the Farne islands, but the short and desultory notes on the species mentioned will hardly repay the reader for his time. The succeeding three essays deal with "wild-fowling" as far removed from Holy Island as North Kent; with "a few comments on sport," and "how I became a naturalist," this last filling eight pages, of which five contributed by another pen, have no connection in the world with the autobiography. With the following two, on "bird migration" and "bird migration from America to Europe," hope rises that at last some new ideas on the subject giving its dominating title to the book are to be disclosed. We are not disappointed by the author.

"Whatever theory is advanced [on this absorbingly interesting question] the idea," writes Mr. Halliday, "baffles the most devoted student of natural history. Yet the query as to the causes of the northern or spring exodus has prompted me to make an effort to explain . . . those laws. . . . Almost without exception . . scientists are agreed that previous to the period termed the Glacial or Ice age, climates were non-zonal—that is, that they were of the same general temperature everywhere from pole to pole. First, that there was an epoch of torrid heat followed by one of tropical heat, and succeeded by one of temperate heat, which gradually passed into one of excessive cold, during which period the higher lands were snow-covered. . . . Since this age the climates have become zonal—a condition which seems to us most natural, because man remembers naught to the contrary.[!] The geological record shows us, however, that everywhere from pole to pole the same life existed during all the periods before the latter part of the temperate Tertiary epoch. Aside from these differences of temperature resulting from elevation . . . there were in the nature of things few reasons for migrations of either fauna or flora . . . when finally the gradual transition from earth-heat control to sun-heat control had taken place, and the Ice age began, these wanderings to and fro become systematic and periodical. The stronger and more active individuals pushed further on than their fellows, as they climbed up further on mountain sides, thereby forming a class apart. They mated and founded new varieties. . . . So here we have, in its earliest and simplest form, the origin of the migratory movements of animals which have developed to such an extent in this day under the present zonal distribution of climates. Thus we may conclude," adds the author, "that, beginning with the first modifications of climate, perhaps at the commencement of the Pleistocene era, the various forms of life being suited to a uniform environment sought in their wanderings to and fro, the continuance of these conditions."

So here at last we have the final word on phenomena which have puzzled generations of ornithologists and others!

After such epoch-making discourses as these, a dozen other essays—evident reprints—follow on a variety of matters unconnected with the subject of the book, yet containing many entertaining observations not to be found in more recent ornithological histories!

The second part of the book describes individually forty-two species only out of the ninety listed on p. 22 as the more or less complete avifauna of Holy Island and region. They are not arranged in any classificatory order, nor, in many cases, do they appear under the generic and specific names which are usually given them by the rules of nomenclature. Fuller and more accurate accounts of these species are to be found in a score of well-known histories of British birds. We are staggered to find in this catalogue of Northumbrian birds the names of the cassowary and the ostrich, sandwiched between the quail and the merlin. We live and learn, however! Of the two final essays, both of which appear under the headline of "The Book of Migratory Birds," the one on North Sea seals may be legitimately included in a work on Northumbrian natural history; but it is a far cry from longshoring on Lindisfarne to "seal-hunting in Greenland," which is the title of the other. The author, however, makes his own apologies in these words:—

"If the able and experienced chroniclers of the migrants in the past have written craving the indulgence of the reader, I feel I am infinitely more in need of such indulgence, and as a man is but mortal . . . his best work is oft-times a sorry attempt."

M

PRINCIPLES OF ANALYTICAL CHEMISTRY.

Theoretical Principles of the Methods of Analytical Chemistry based upon Chemical Reactions. By Prof. M. G. Chesneau. Authorised translation by Prof. Azariah Thomas Lincoln and Prof. David Hobart Carnahan. Pp. x+184. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 7*s.* 6*d.* net.

IN the introduction it is stated that this book represents the reproduction of a series of lectures delivered in the Collège de France on the principles involved in the methods of analytical chemistry. The reversible and irreversible reactions which are involved in analytical processes are discussed, on the one hand, from the point of view of the theory of electrolytic association, and, on the other, from that of the heat changes which accompany these reactions.

It is obvious that the comparative examination of the facts of analytical chemistry from these two points of view represents a theme to which considerable interest would attach if the comparison were made by a chemist thoroughly familiar with both aspects of the question, and yet untrammelled by adhesion to any particular doctrine. Unfortunately this is not the case, and it is perhaps partly due to the author's lack of familiarity with the present position of the ionic theory that his verdict is given in favour of the so-called calorimetric theory. The evidence which leads to this result is very far from convincing, for whereas great stress is laid on the difficulties, real and apparent, which are involved in the adoption of the ionic theory, the improbable consequences which attach to the application of the calorimetric hypothesis are accepted without criticism

Only a brief reference can be made to a few of the many points which call for comment. In terms of the calorimetric theory we find that acids are classified as strong, medium, and weak according to the quantities of heat liberated in the process of neutralisation. The decrease in the activity of a weak base, such as ammonia, on the addition of a corresponding salt, is attributed to the production of acid by hydrolytic decomposition of the salt. An attempt is made to refute the ionic explanation of the similar influence of salts on weak acids by reference to experiments on the rate of solution of zinc in solutions of acetic acid to which various metallic acetates were added. Such experiments are in reality of far too complicated a nature to allow of the results being interpreted in favour of or against any particular theory.

In the discussion of osmotic pressure, the early measurements of Pfeffer and Ponsot are cited, but no reference whatever is made to the work of Morse and his collaborators, or to that of Hartley and the Earl of Berkeley.

Certain generalisations, drawn by Ponsot from transport measurements by Chassy, are brought forward as being more important than all the excellent experimental work done on the subject from the time of Hittorf onwards. Here, as in so many other instances, the lack of the author's knowledge of recent work on the nature of solutions of salts is lamentably apparent.

In the treatment of indicators, Ostwald's long-discarded ionic explanation is the only one which the author sees fit to compare with that based upon the calorimetric theory.

These references suffice to indicate that the author has failed to do justice to his subject, but this review would be incomplete if attention were not directed to the unsatisfactory character of the translation. In view of the fact that the academic title of the second translator is that of associate professor of Romance languages, a rendering of the original into tolerable English might have been reasonably expected. To show that this anticipation is not fulfilled, the first paragraph on p. 4 may be quoted:—

"The processes of analytical chemistry consist, in general, in bringing each element successively to the state of a definite compound in a final system, formed of distinct phases, whose nature lends itself easily to a separation by purely mechanical processes."

This conglomeration would appear to be the result of a too literal translation.

Apart from the publisher's share in the production of the work, the reviewer can find nothing to recommend it, and the translation represents a good deal of misspent time and energy. H. M. DAWSON.

MORE MOSQUITOES.

A Monograph of the Culicidae or Mosquitoes. Mainly Compiled from Collections Received at the British Museum. By Fred V. Theobald. Vol. v. Pp. xv+646+6 plates. (London: British Museum (Natural History), Longmans and Co., B. Quaritch, and Dulau and Co., 1910.) Price 1*l.* 5*s.*

SOME few years ago a critic observed that, owing to the system of classification adopted for the Culicidæ, to describe a new species "and call it a genus" was far easier than to determine its true systematic position. Since then, such has been the activity of genus-makers, the condition of affairs as regards the nomenclature and taxonomy of the known mosquitoes has become infinitely worse. No entomologist of repute will deny that, were characters so trivial as those now employed for the distinction of most of the so-called "genera" among Culicidæ made use of in other orders of insects, or in other families of Diptera, the result would be little short of chaos. Sooner or later the whole question of mosquito classification will have to be reconsidered; meanwhile the subject awaits the advent of a properly qualified systematist, gifted with breadth of view and possessing a sound knowledge of fundamental principles.

The book before us, which is a continuation, and, in some respects, a *résumé* of the previously published volumes of Mr. Theobald's well-known work, is constructed upon the same lines as its predecessors, and certainly bears witness to the industry of its author. We are told in the "Introduction" that, since the appearance of vol. iv. in 1907, the genera of Culicidæ have been increased by twenty-one and the recognised species by no fewer than three hundred and ninety-two, though it would seem that not all of the latter are actually new; thirteen of the genera, however, and eighty of the species are now described for the

first time. Since the first two volumes of the monograph (published in 1901) have long been out of print, the appearance of the present instalment is opportune, and the tables for the determination of genera and species, with which it is copiously provided, will doubtless prove useful to many. The figures are clear and well executed, and misprints are few.

The author's English, however, not infrequently makes the sensitive reader shudder; for instance, the first sentence of the book includes the words, "they tabulate as follows," and this remarkable phrase, in which "tabulate" is used as an intransitive verb, is repeated again and again in the course of the volume. As additional examples of faulty phraseology we may quote:—"It probably comes in *Myzomyia*" (p. 22); "it cannot be said as to what *pictus* really is" (p. 25); "A number of allied genera come around it and they keep on increasing in number" (p. 151). More serious than this is a flagrant error in terminology. Diptera, as is well known, have a five-jointed tarsus, but Mr. Theobald not only employs the objectionable, because etymologically incorrect, term "metatarsus" for the first joint of the tarsus, but calls the second and third joints the "first and second tarsals," and so on; this is confusing as well as wrong, and would lead a novice to suppose that in the Culicidæ the tarsus is four-jointed.

With reference to the disseminator of yellow fever, it may be noted that the author has decided to retain the name *Stegomyia fasciata*, Fabr., instead of regarding the specific designation as preoccupied and substituting for it *calopus*, Mg., as is the practice in the United States. On the ground of common sense as well as expediency, the course adopted in the British Museum monograph, though not in accordance with the accepted rules of zoological nomenclature, is undoubtedly the best. Mr. Theobald should not, however, perpetuate a slip made in his last volume, by stating that "Villiers described a mosquito (1789) as *Culex fasciatus*," the original author of the name in question, which dates from 1764, being O. F. Müller, whose brief description, accompanied by a reference to the work in which it appeared, was copied by de Villers (not Villiers) in 1789.

PHILOSOPHY.

Philosophical Essays. By B. Russell, F.R.S. Pp. vii+185. (London: Longmans, Green and Co., 1910.) Price 6*s*. net.

THE subject-matter of Mr. Russell's book may be gathered from the titles of his chapters—"The Elements of Ethics," "The Free Man's Worship," "The Study of Mathematics," "Pragmatism," "William James's Conception of Truth," "The Monistic Theory of Truth," "On the Nature of Truth and Falsehood." With the exception of the last, all are reprints, with some alterations, of articles which have appeared in the *New Quarterly, Hibbert Journal, Independent Review, Albany Review, Edinburgh Review,* and Proceedings of the Aristotelian Society.

In the first essay the author states his own determinist convictions, and points out that determinism does not interfere with morals, for, as a matter of fact, people never do believe that anyone else's actions are not determined by motives, however much they may think *themselves* free.

"If we really believed that other people's actions did not have causes, we should never try to influence other people's actions." "Most morality absolutely depends upon the assumption that volitions have causes."

In the third essay there is a fine statement of the "supreme beauty—a beauty cold and austere, like that of sculpture," which the mathematician sees in his subject; also some good hints on teaching. But the largest part of the book, and perhaps the most interesting, is that in which the author combats the new philosophy—or some aspects of it—which is mainly represented by Dr. Schiller, now that its great American protagonist is gone from among us, to the regret of all students, whether disciples or philosophical enemies.

Mr. Russell is an empiricist, and therefore agrees with pragmatism's readiness to treat all philosophical tenets as working hypotheses only; but he dissents from its conception of the nature of truth. If utility is to be a criterion of truth, it is not a useful criterion, for it is usually harder to discover whether a belief is useful than whether it is true (*e.g.* papal infallibility). Therefore the pragmatist theory does not "work," and the pragmatists are hoist with their own favourite petard. As to the "will to believe," Prof. James ignores the distinction between believing and entertaining an hypothesis. If a man comes to a fork in the road, and does not know which branch to take, it is a "forced option" from the point of view of action, for he must take one of them if he is to arrive at his destination. But his *belief* is not forced. He neither believes nor disbelieves that he is on the right road, until he finds out by asking somebody, or by sign-posts, or from other sources of information. *The Will to Believe* "assumes that if we do not completely believe an hypothesis, we must either completely disbelieve it or wholly suspend judgment." But the fact is that all experiment, both in science and daily life, implies a state of mind which accepts neither alternative. Actions are based on probabilities.

There is much further acute criticism, but the author expresses his great respect and esteem for William James, and his deep sense of the public and private loss occasioned by his death.

HEREDITY.

Heredity in the Light of Recent Research. By L. Doncaster. (Cambridge Manuals of Science and Literature.) Pp. x+140. (Cambridge: University Press, 1910.) Price 1*s*. net.

MR. DONCASTER has performed a remarkable feat in condensing into so small a space such an admirable introduction to the study of heredity in the light of recent research. He writes clearly, without dogmatism, he treats fairly both the Mendelian and the biometric schools, and shows excellent judgment in what he includes and in what he omits.

The book begins with a discussion on the nature of heredity and variation, showing how the study of one is bound up with that of the other, and how both

bear on the problem of evolution. The different kinds of variation, their nature and their causes, next come in for consideration, and the methods of investigating them are dealt with. Then follows a chapter on the statistical study of heredity, which includes a description of the simplest method of measuring correlation. Chapters v. and vi. treat of the Mendelian form of inheritance, both as it is seen in a single pair of allelomorphs, and when it is complicated, as in the inheritance of coat colour in rats and mice, by the dependence of the character on two separately inheritable factors. This is succeeded by a discussion "on some disputed questions," which range from the apparent incomplete segregation of coat-characters in the descendants of a cross between long-haired (Angora) and short-haired guinea-pigs to the inheritance of acquired modifications. The treatment of these problems is suggestive rather than exhaustive.

The final chapter deals with heredity in man. The more important conclusions obtained by the use of statistical methods are mentioned, and cases are described where the inheritance of particular characters may be explained on Mendelian lines. Among the latter are included the presence or absence of pigment in the front of the iris observed by Hurst, and Nettleship's remarkable pedigree of "night-blindness," which appears to behave as a Mendelian dominant. Finally, the importance of inheritance in the consideration of certain sociological questions is insisted on. Two appendices are added, (i.) "Historical Summary of Theories of Heredity," and (ii.) "The Material Basis of Inheritance."

The excellence of the print and paper are deserving of especial mention. The latter is thin but opaque, with a very smooth, but not an offensively glossy surface. This enables the diagrams of variation and pedigrees, &c., to be reproduced very clearly though on a small scale, while the half-tone blocks are better printed than in many a more expensive work.

E. H. J. S.

EARLY EGYPTIAN REMAINS.

The Tomb of Two Brothers. By Miss M. A. Murray. (Handbook, Manchester Museum.) Pp. 79+21 plates. (Manchester: Sherratt and Hughes; London: Dulau and Co., 1910.) Price 5*s*.

IN 1907, during the exploration of a series of tombs at Der Rifeh, the cemetery of the ancient Egyptian town of Shas-hotep, near Assiut, a concealed and hitherto unrifled chamber was discovered. Prof. Flinders Petrie, recognising the importance of the contents being kept together and scientifically examined, suggested that in consideration of a subsidy towards the work at Memphis, the tomb and its contents should be placed at the disposal of the Manchester Museum. Through the liberality of friends the sum required, with a balance sufficient to defray the cost of the present monograph, was provided. The report has been edited by Miss M. A. Murray, who has secured contributions from experts on the many points of interest connected with the discovery.

The tomb belongs to the twelfth dynasty, and supplies two of the earliest mummies which have hitherto been subjected to scientific examination. They were placed in highly decorated coffins enclosed in elaborate cases, while the viscera were, as usual, deposited in so-called canopic jars. Each of the deceased was provided with a statuette as a home for the Ka, or separable soul, and the chamber also contained two figures of girls bearing offerings for the dead, and boats provided for the journey of the soul to its final rest.

Various novel and interesting questions are discussed by Dr. J. Cameron in his elaborate report on the anatomy of the remains. The inscriptions indicate that the bodies are those of two personages named respectively Nekht-ankh and Knumu-nekht, the former an elderly man, the latter middle-aged, both of small stature, about 5 feet 3 inches high. The slimness, delicate moulding, and faintness of the muscular impressions in the case of Nekht-ankh indicate a feminine type; and Dr. Cameron infers that he was a eunuch, or at least he designates the type as eunuchoid. Further, the extraordinary fact is disclosed that on him the operation of subincision, familiar to all students of Australian native tribes, but hitherto not recognised in Egypt, had been performed. In this connection it is significant that the right lateral incisor of the upper jaw had been removed; and it can hardly be a mere coincidence that the removal of this tooth, possibly as a means of propitiating Nemesis or to subserve some obscure magical purpose, is a part of this rite in Australia. These curious facts deserve, and will doubtless receive, due attention from anthropologists.

It is also remarkable that the skulls of these two brothers, sons at least of one mother, differ widely in structure. That of Knumu-nekht, the younger, is extremely prognathous, with an alveolar or gnathic index of 104·34, while that of his eunuchoid brother is remarkably orthognathous, with an index of 93·8, that of Englishmen being 96. The obvious explanation is that these men were sons of one mother by different fathers, the prognathous type indicating admixture of some negroid stock, such as that which has been recognised by Prof. Eliott Smith in some Nubian cemeteries. It is a proof of the artistic capacity of this early period that the carver of the statues of the brothers clearly indicated these variances of racial type.

Manchester is to be congratulated on the acquisition of a collection of the highest anthropological interest, on the liberality of the citizens who secured its possession, and on the skill and learning which the writers have bestowed upon this admirable monograph.

PHOTOGRAPHIC PRACTICE.

A Primer of Photography. By Owen Wheeler. Pp. vii+202. (London: Methuen and Co., Ltd., n.d.) Price 2*s*. 6*d*. net.

WE have read this volume with much pleasure, because it consists of a plain and straightforward statement, by a man of experience, of those facts that one who has just begun to photograph will find profitable. The author gives no preface or introduc-

tion, relying presumably on the title as a sufficient indication of his aim. He deals with the practice rather than the underlying principles of photography, though these and historical details are not altogether neglected. He does not repeat such instructions as are enclosed in every box of plates or packet of paper, and refers without hesitation to various proprietary articles and to expense. As might be expected, the author regards his subject from the point of view of the present-day beginner, and it is in this that the volume differs from the older primers. There is no attempt to indicate methods of manufacture, because no one at the present time prepares his own sensitive material. There are no tables of exposures necessary in various circumstances, because "here the exposure meter or guide comes into play." Films are not treated of as if they almost needed an apology for their introduction, nor hand-cameras as if they were inferior in almost everything else but price to the instruments supported in a more stable manner.

Although no two teachers would make exactly the same selection of processes as being best suited to the beginner, and making all due allowance for personal preference, we are rather surprised that the common mercury and ammonia method of intensification is not referred to, the two methods recommended being the uranium and the silver cyanide methods, both of which are more troublesome than the other. The statement that plates are made orthochromatic "by bathing ordinary plates in a colour sensitiser" is likely to mislead the beginner in this detail of manufacture. Of course, the sensitiser is added to the emulsion, bathing being quite an exceptional process. There are a few matters, particularly in the optical part, that might be revised with advantage, but these are not of prime importance. The chapter on "Telephotography" explains the manner of using the special lenses constructed for this purpose in a more simple and at the same time complete manner than we have ever seen elsewhere.

STARS IN SEASON.

Round the Year with the Stars. By Garrett P. Serviss. Pp. 147. (New York and London: Harper and Brothers, 1910.) Price 5*s.* net.

THIS volume takes quite a different line from that of "Astronomy with the Naked Eye," by the same author, the points of overlap between the two volumes being infrequent and unimportant. In the earlier work Mr. Serviss described the legends and myths which so profusely surround the old constellations; in the present volume he endeavours to cultivate a personal knowledge with the chief units of the celestial pageant.

In the four principal chapters (i.–iv.), the sky is taken at each of the four seasons—spring, summer, autumn, and winter—and is so described that the beginner may locate, with but little trouble, the constellations and their *lucidae*. This may sound rather a hackneyed procedure, but in the hands of Mr. Serviss, whose poetic enthusiasm for the stars is, on every page, as obvious as his wide knowledge, it becomes most interesting and instructive. For example, he introduces (p. 25) a discussion as to the most suitable season for the commencement of the year, deprecating January, when nature is asleep, as compared with spring, when the glorious re-birth takes place. A reference to Sir Norman Lockyer's researches on the different years would have further elucidated the subject. The fact that our constellation Virgo is similarly named in ten different and ancient languages is the type of fact that makes the work so interesting. But the physical attributes of the individual objects are not neglected; the powder of science is judiciously mixed with the jam of poetic mythology. The description of Spica's magnitude, intrinsic brilliance, and enormous velocity, given on p. 31, should be appreciated by the least scientifically inclined sky-gazer. It is helpful to find the common, countryside names given beside the Arabic names and the Bayer Greek letter.

In discussing the colours of companions, the author is, we believe, rather too dogmatic when he states definitely (p. 89) that the complementary colours are not the effect of contrast. Recent researches rather tend to contradict this, and we look upon the footnote reference to Dr. Louis Bell's work (p. 90) as a negation of the author's dictum. The four seasonal and the six ordinary charts are nicely done, but we fear they are not of sufficient size or contrast to aid the beginner in his actual observations. The appendices are very interesting, and after reading through the first, which gives the Christianised names of the constellations, the beginner will probably shudder at the possibility of having to use the genitive singular of "The Red Sea with Moses Crossing It," Schillerius's "improvement" on Eridanus. W. E. R.

A PAIR OF TIGER BOOKS.

(1) *Anecdotes of Big Cats and other Beasts.* By David Wilson. Pp. viii+312. (London: Methuen and Co., Ltd., 1910.) Price 6*s.*

(2) *The Life Story of a Tiger.* By Lt.-Col. A. F. Mockler-Ferryman. Pp. iv+253. (London: A. and C. Black, 1910.) Price 3*s.* 6*d.*

(1) IT has been suggested that one reason for the greater prevalence of man-eating tigers in India, as compared with man-eating lions in Africa, is due to the superiority in courage of the natives of the latter over most of those of the former country. Whatever may be the truth of this assertion as regards India, it most certainly does not apply to Burma, where, according to Mr. Wilson, it is a common practice for the relatives or neighbours of a person carried off by a tiger to pursue the murderer then and there, armed only with spears, or other primitive weapons, in order to recover the body. Some faint idea of the courage necessary for such a primitive expedition may be gleaned, observes the author, by anyone who tries to take a bone from a savage dog. In one instance recorded in Mr. Wilson's book four old men started to rescue the body of the granddaughter of one of the party, and succeeded in badly wounding the tiger, although with the death of one of the heroic four, and the maiming of a second. But this act of heroism is exceeded in a case where

the first of a party of three young girls walking in single file through the jungle was seized and carried off by a tiger. Nothing daunted, the second girl, seizing a chopper from the one behind her, rushed in pursuit, and actually killed the striped marauder by a rain of blows on its head. It is true that both anecdotes rest on native testimony, but they seem to have the impress of truth.

Mr. Wilson's book is, however, by no means confined to tigers, and will be found to contain a number of more or less interesting observations on the habits and character of many denizens of the Burmese jungles, from meloks downwards to snakes and lizards.

(2) Colonel Mockler-Ferryman's volume, on the other hand, is a "tiger-book" pure and simple, and for those who enjoy animal "autobiographies" is an excellent example of that class of literature, for the author appears to be thoroughly well-acquainted with the habits of the striped tyrant, and records the history, in what are supposed to be the animal's own words, of a member of the race from cubhood to mature age. Incidentally he mentions that there are "castes" among the species, and that the sleek hill-tiger, with a fully-striped coat, is an altogether superior class of animal to its fat, and often sparsely striped, brother of the lowlands. An attractive feature of the volume is formed by the eight coloured plates, reproduced in excellent style by the tricolour process from sketches by Mr. Harry Dixon. Whether when a tiger has knocked over a sambar stag by a vigorous rush, its mate would take a flying leap on to the victim in the manner shown in the plate on the cover of the volume, I am not competent to say, but the action certainly looks like a somewhat unnecessary display of energy. In the plate representing a tiger clinging to the shoulders of a tame buffalo in the arena of a native chief, the horns are of somewhat antelope-like type, but we are told on p. 16 of the text that the buffalo in question, together with its fellows, possessed horns of abnormal shape. R. L.

OUR BOOK SHELF.

Anton Dohrn: Gedächtnisrede gehalten auf dem Internationalen Zoologen-Kongress in Graz am 18 *August*, 1910. By Prof. Th. Boveri. Pp. 43. (Leipzig: S. Hirtel, 1910.) Price 1.25 marks.

ALTHOUGH the labours and personality of the late Anton Dohrn have been strikingly presented in this journal, the motives that led him to found the "Stazione Zoologica" and the influence he has exerted are matters of great interest, not to be exhausted by a single article. In a wonderfully artistic manner this aspect of Dohrn's life is made clear in a speech delivered by Prof. Boveri during the Graz Zoological Congress last August, and now published by Hirtel, of Leipzig.

In that pure, nervous German to which he has accustomed us, Prof. Boveri sets forth the inspiration that led Dohrn to undertake his life-work, the capacity that enabled him to overcome difficulties of the severest nature, and to win support of the most international character. Now that it is done we are apt to forget the originality, the clear-sightedness, and the zeal which underlaid such a splendid success; and it is well that the man himself should be known who has raised on alien territory buildings that cover 2000 square metres, that enclose 250 rooms, and employ fifty officials. The international value of such a laboratory is immense, and the work is that of one man who faced the forebodings of failure from his father, friends, and colleagues, who strove against misfortune upon misfortune, and who, in spite of this, staked his whole interest in the ultimate success of the scheme. The speech is one of lasting value.

Fly-Leaves from a Fisherman's Diary. By Captain G. E. Sharp. Pp. xi+175. (London: Edward Arnold, 1910.) Price 5s. net.

BOOKS about fishing, and above all about dry-fly fishing, are so constantly appearing that the reader tends to become critical, not to say fastidious. Yet we do not think that the most fastidious will complain of Captain Sharp's little book. The writing of it has obviously been a labour of love undertaken by a keen sportsman, and an ardent lover of nature and open-air life. The episodes described are ordinary, and, we had almost written, commonplace, but they are set forth with the charm which is inseparable from the descriptions of the really sympathetic student of the life of a river.

It has been the good fortune of the author to find employment in a country town within bicycling distance of the water that he fishes, and, month by month, he has been able to spend his days and half-days of leisure by the river. Month by month he has described his days, or some of them, for, "Even in fishing there are sometimes evil days, but they are not the days which we remember." The book is illustrated with three really admirable pictures of stretches of a chalk stream and a charming view of a nameless Wiltshire village. L. W. B.

Mating, Marriage, and the Status of Woman. By James Corin. Pp. xii+182. (London and Felling-on-Tyne: Walter Scott Publishing Co., Ltd., 1910.) Price 2s. 6d. net.

IN an essay of considerable interest, the author reviews the causes which have led to the development of the relations existing between the human male and female.

The phenomenon of a relatively inferior female bound to a relatively dominant male is peculiar to man. The contention is that the marriage system is the cause of human progress while at the same time it affords an explanation of woman's physical and mental inferiority. Progress depends on the birth-rate. If woman is to be a highly developed breeding machine she must occupy an inferior position, being economically dependent on the male. Centuries of selection, for breeding purposes, of the feeblest, most submissive, and patient of women have had a marked effect.

Mating, in which the woman was free, belongs to the first period of human affairs, and marriage to the second. In the opinion of the author, the marriage system, fostered by militarism, has developed from the practice of communal rape, and the relation of victorious soldiers to captive women. According to Skeat, the word wife is allied to vibrare, to tremble; hence wife means a trembling thing, a captive. The essay is interesting and the argument is well sustained.

Mother and Child. Being Letters from an Old Nurse to a Young Mother. By L. M. Marriott. Pp. 126. (London and Felling-on-Tyne: Walter Scott Publishing Co., Ltd., 1910.) Price 1s.

IN a small volume of 120 pages much sound advice is given about the management of pregnancy, the health of young mothers, the care of infants, the early training of children, and other domestic matters.

The book is written in the form of letters from a nurse to her patient. It is intended for the laity. The instructions are practical and the teaching is in accord with the modern school of obstetrics.

It is questionable what advantage is gained by presenting medical subjects in this way, but if women are to be supplied with information on these subjects it could not be better given.

The book is of handy size, and it is supplied with an index. The type is good.

The Modern Geometry of the Triangle. By W. Gallatly. Pp. 70. (London: F. Hodgson, n.d.) Price 2s. 6d.

THE principal novelties in this tract are the chapters on the orthopole (with some original propositions by the author) and on orthogonal projection (mostly after Prof. Neuberg). A pretty theorem in the latter is that all equilateral triangles in a given plane project upon another plane into triangles having the same Brocard angle. The other four chapters discuss various kinds of coordinates, the Lemoine and Brocard points, pedal and anti-pedal triangles, the medial triangle, and the Simpson line. No reference is made to the Tucker circles, or to Kiepert's hyperbola; even the Brocard circle is unmentioned, so the tract is deficient, even as a summary of the most important parts of the subject. A rather irritating feature is that the symbol $\propto$ is used for two entirely different purposes; this might easily have been avoided. Perhaps the figures will be found as useful as anything in the tract, for although they are not particularly good, they are drawn so that the special points are far enough apart, which is not very easy to contrive when a student is drawing figures for himself. M.

Paul Appell: Biographie, Bibliographie analytique des Ecrits. By Ernest Lebon. Pp. viii+71. (Paris: Gauthier-Villars, 1910.) Price 7 francs.

THIS volume is the latest addition to the excellent series of biographies published under the general title, "Savants du Jour," to which attention has been directed on several occasions in these columns. The brochure maintains the high character of the series.

A biography of Prof. Appell, in which an interesting account of his early experiences during the siege of Strasburg, where he was born in 1855, is followed by an exhaustive list of the academic distinctions, honorary titles, prizes, and decorations which have been conferred upon him during his strenuous life. His work in mathematical analysis was eulogised by M. Charles Hermite in 1889, on the occasion of Prof. Appell's receiving a gold medal at a conference presided over by King Oscar II.; and the appreciation is here printed. M. Gaston Darboux's account of the researches in geometry, for which Prof. Appell received the Bordin prize of the Paris Academy of Sciences, is also included in the volume. A complete list of the papers and addresses of the subject of the biography completes what is a valuable record.

A Flower Anthology. Selected and illustrated by Alfred Rawlings. Pp. iv+163. (London: Philip Lee Warner, 1910.) Price 5s. net.

THE quotations in this collection have been selected from the works of many well-known poets, but more especially from Wordsworth, Shakespeare, Herrick, Chaucer, and Keats.

The poems have been classified roughly into those dealing with the seasons of the year, and the changes in the animal and vegetable world associated with them. We are glad to see Edmund Spenser's "The Pageant of the Year," which gives a fine description and picture of nature in the different seasons and months.

The illustrations form a pleasing addition to the volume, which should meet with the approval of all lovers of poetry. The book is, moreover, very tastefully bound.

Hazell's Annual for 1911. A Record of the Men and Movements of the Time. Edited by Hammond Hall. Pp. lix+592. (London: Hazell, Watson and Viney, Ltd.) Price 3s. 6d. net.

THE twenty-sixth issue of this useful reference annual is so much up-to-date that it contains a biographical list of members of the new House of Commons. So varied are the contents of the volume that it will appeal to workers in most spheres of human activity. The man of science will find, among other useful contents, articles on scientific progress in 1910, aërial navigation in 1910, Imperial research, scientific institutions, higher education, forestry, and afforestation, agriculture, and daylight saving. It is remarkable how much information has been packed into a small space.

Plant Anatomy from the Standpoint of the Development and Functions of the Tissues and Handbook of Micro-technic. By Prof. W. C. Stevens. Second edition. Pp. xv+379. (London: J. and A. Churchill, 1910.) Price 10s. 6d. net.

THE first edition of Prof. Stevens's work was reviewed in NATURE for July 9, 1908 (vol. lxxviii., p. 219). The present issue has been enlarged by the addition of a chapter on reproduction, and the volume has been revised generally.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Recent Earthquakes in Asia.

I AM informed by Mr. G. W. Walker, superintendent of Eskdalemuir Observatory, that the records of the seismograph according to the design of Prince Boris Galitzine, which was recently presented by Dr. Arthur Schuster to the observatory, give the positions of the epicentres of the recent earthquakes in Asia as follows:—

January 1, lat. $36\frac{1}{2}°$ N., long. 66° E.
January 3–4, lat. 42° N., long. 77° E.

The first place is in the Hindu Kush range of Afghanistan, north-west of Cabul. The second is in the north-east of Turkestan, near its junction with the Chinese and Russian Empires. W. N. SHAW.

Meteorological Office, South Kensington, London, S.W., January 9.

As it is unusual for the Kew magnetographs to be affected by earthquakes, it seems worth mentioning that on the occasion of the Turkestan earthquake, near midnight (G.M.T.) of January 3, both the declination and horizontal force traces show unmistakable effects. The magnets oscillated in a way characteristic of mechanical shocks. According to our Milne seismograph, the preliminary seismic tremors reached Kew about 11.35 p.m., and the large waves about 11.47 p.m., when the limits of registration were exceeded for a minute or so. There was then a comparative lull until about 11.54, when the limits of registration were again exceeded, and these very large movements continued with short interludes for more than fifteen minutes.

The apparent times of commencement of the oscillatory magnetic movements are about 11.53 in the declination and 11.55 in the horizontal force curves, and for four or five minutes the oscillations were so continuous that no

trace is clearly shown. From 11.35 to 11.38 there was a very rapid easterly movement of about 4′ in the declination trace, of a non-oscillatory character. The close agreement in time of this movement with the arrival of the preliminary tremors is very likely a purely accidental coincidence; but the movement is of an unusual character, and it would be interesting to know what was being recorded at the time at other magnetic observatories. The movement may, of course, have been due to some purely local source, *e.g.* abnormal electric-tram currents.

C. CHREE.

Kew Observatory, Richmond, Surrey, January 7.

Singularities of Curves and Surfaces.

THERE is a distinction between *multiple* points and what, for want of a better word, I have called *singular* points. The curve $au_p + u_{p+1} = 0$ has at A a *multiple* point of order p, but not a *singular* point. The latter points are defined in § 169 of my "Geometry of Surfaces," reviewed in NATURE of December 22, 1910 (p. 231), and the definition may be illustrated as follows. Let multiple points of orders $p, q, r \ldots$, where p is not less than $q, r \ldots$, move up to coincidence along a continuous curve; then the compound singularity thereby formed is a singular point of order p. The curve of lowest degree, which can possess a singular point of given order, depends on the way in which the singularity is formed. Thus if four nodes move up to coincidence along a conic, the resulting singular point is of the second order; but a quintic is the curve of lowest degree which can possess such a singularity. Also, if three nodes move up to coincidence along a straight line, the singular point is still of the second order, but no curve of lower degree than a sextic can possess such a point.

The reviewer's statement in the second paragraph is misleading, and calculated to convey a false impression, since the investigations referred to are applicable to surfaces of any degree. The fact is that a quartic surface is capable of possessing most of the simpler singularities. The principal exceptions are triple lines, which cannot be completely discussed without the aid of a surface of the seventh degree, and cuspidal twisted curves, which necessitate the employment of a quintic surface, since a quartic surface, which possesses a cuspidal twisted cubic curve, is a developable surface, and is therefore not sufficiently general for the purpose in question.

As science advances, the introduction of new words is essential. Thus lithotrity, ovariotomy, scleroderma, &c., have been introduced during the last century to designate operations and diseases of which our ancestors were ignorant, whilst algebra has been enriched by such words as catalecticant, evectant, protomorph, &c. The choice of suitable words requires care, but I adhere firmly to my opinion that Latin and Greek are the best languages to employ.

A. B. BASSET.

December 23, 1910.

IT is unfortunately impossible to give a very brief rejoinder to Mr. Basset's letter; and it is perhaps as well to take the opportunity of giving a further statement of my position in reference to singularities on a plane curve.

In the first place, the distinction drawn in Mr. Basset's letter between *multiple* points and *singular* points of order p does not seem to be in agreement with the practice followed in his book, where the two terms appear to be used indiscriminately: thus in §§ 171–4 and § 181 the term *multiple* point is invariably applied to singularities which, according to his letter, he would now call *singular* points. At any rate, the singularities considered in these articles cannot occur (in their general forms) on curves of degree $(p+1)$, and, as I understand Mr. Basset's letter, he intends the use of the term *multiple* points to be restricted to those singularities which do occur on curves of degree $(p+1)$. Naturally such a restriction would justify the assumption made in § 165, which was criticised in my review; but no modification of terminology will answer the question as to whether *all* types of singularity can be obtained by Mr. Basset's treatment of the subject.

The singularities which were in my mind when I raised this question were those considered by Zeuthen (*Math. Annalen*, Bd. x.) and Jordan ("Cours d'Analyse," t. 1, chap. v.); a fairly simple example is given by the origin on the curve $x = t^6$, $y = t^{12} + t^{15} + t^{16}$.

Zeuthen's method enables us to determine the Plücker-equivalents of the singularity, and Jordan shows how to find quadratic transformations which reduce the singularity to a simpler character. But I do not see that Mr. Basset's limiting process (as briefly indicated in his letter) would enable us to handle any singularity of this type (called a *cycle* by Jordan), nor have I found any reference to the existence of such types in Mr. Basset's book.

T. J. I'A. B.

Scottish Natural History.

I SEE that NATURE of December 29, 1910, refers to two statements made before a natural history society by Mr. Symington Grieve, viz.:—

(1) That half a century ago white-tailed eagles were more abundant than golden eagles, or words to that effect.

(2) That Mr. Grieve is of the opinion that wild cats are on the increase in Scotland owing to the instructions issued by proprietors and factors for their protection.

With regard to the first, naturalists would like to have further data. It is certainly true white-tailed eagles *were* then vastly more abundant than now, and that they are now verging on extinction as an existing species. But that they were "far more numerous half a century ago than the golden eagle" requires more exact statistics. Forty years ago there were quite eighty eyries of golden eagles occupied over all Scotland, but I cannot find any *evidence to prove* that white-tailed eagles at any time anywhere in Scotland even approached that figure, and during at least forty years I have paid considerable attention to all statements made as to their distribution and their subsequent decrease. Locally in some few districts white-tailed eagles were more numerous than golden eagles, but not generally, and I believe all occupied eyries could at any time have been easily counted.

As regards the increase of wild cats, that is also quite undoubted, but the true reason is not the direct instructions given by proprietors or factors generally, though that may have some local value also, but to the protection afforded by the increased area of lands devoted to deer afforestation.

T. A. HARVIE BROWN.

Dunipace, Larbert, Stirlingshire, N.B., December 29, 1910.

The Origin of Man.

THE following extract from a review in "Dodsley's Annual Register for 1767" of Dr. Adam Ferguson's essay on the "History of Civil Society" may be of interest:—

"Many of the authors who have written on man, and those too, some of the most ingenious, have set out by considering him as an animal. . . . Nay, one in particular has thrown out doubts of his having been originally a monkey or baboon." (The reviewer goes on to speak of this theory as "too ridiculous for serious animadversion.")

Could any of your readers say who was the "one in particular"?

CHARLES E. BENHAM.

Colchester, January 7.

COLLIERY WARNINGS.

WHEN an appalling colliery disaster, like that at Hulton Colliery, happens to coincide with a "colliery warning," public attention is naturally attracted to the fact, and the warning at once becomes invested with an appearance of importance that is out of all proportion to its true value. There appears to be an impression that these colliery warnings are issued by some central responsible authority, such as the Meteorological Office might be, and that they are based upon sound scientific principles, but as a matter of fact they are issued by the Press Association, and are

apparently issued in defiance of all the dicta of science and all the teachings of practical experience. All these warnings are based on the assumption that a high barometric pressure indicates a condition of danger for the coal miner; for example, the warning published on December 19 last states:—"While the glass remains at about its highest level, miners are advised to beware of escapes of firedamp from the strata." The entire falsity of this assumption has been repeatedly pointed out in the technical press, but as the warnings are still being issued on the same lines, it may be worth while to place the main data on the subject before those interested in the matter.

Firedamp occurs occluded in coal, and also contained under pressure in cavities and fissures in the coal seam itself and in the strata adjacent to it. Furthermore, in every colliery there are larger or smaller areas from which the coal has been removed, and which are more or less loosely filled with débris, either deliberately thrown or packed in to fill up partly the empty spaces, or due to the breaking down of the roof of the coal seam. Such a partially filled space is known technically as the "goaf"; the ventilating current in a colliery traverses the various roadways and workings, passes along the working faces of the coal, and may sweep along the edge of the goaf, but the goaf itself is never ventilated. Hence in a fiery colliery the goaf gradually fills with a mixture of firedamp and air. The object of the ventilating air current is to dilute the firedamp given off gradually from the coal faces, or coming off more rapidly from cavities (firedamp escaping in this way being known as a "blower"), to such an extent as to produce a non-explosive atmosphere in all accessible parts of the mine.

A gas explosion can only occur in a properly worked colliery when an evolution of firedamp takes place in excess of the normal, and the question directly before us is how this rate of evolution of firedamp can be affected by changes of atmospheric pressure. It is an obvious truism that increase of pressure must tend to prevent the escape of firedamp from the coal or the strata of rock. In the case of gas contained in cavities, this is often under very great pressure, as high as 30 atmospheres having been recorded by actual measurement, and in such circumstances, even a considerable change in the height of the barometer, say 3 inches, amounting to only one-tenth of an atmosphere, would have but little influence. On the other hand, blowers sometimes give off gas at pressures not greatly above that of the atmosphere, and then fluctuations of atmospheric pressure may have a decided effect. Thus in the *Colliery Guardian* of December 13, 1907, Mr. D. S. Thomas gives a record of his observations on a blower extending over a twelvemonth, in which he found that the flow of gas from the blower increased quite regularly whenever the barometer fell, so much so that "the slightest change in barometric pressure was shown more delicately than the barometer itself could record it."

As regards occluded gas, it is quite certain that this comes off more readily when the coal is placed under diminished pressure. Numerous investigations have been made on this point, and it has been found that whilst a small reduction of pressure causes the occluded gas to commence to come off, yet even after many hours' exposure in a vacuum at ordinary temperatures, a considerable proportion of the gas is still retained. As regards therefore the gas contained in the coal and the surrounding rocks, it appears to be beyond controversy that a low barometer must necessarily correspond to a somewhat increased evolution of firedamp.

The gas contained in the goaf is under somewhat different conditions; so long as the air in the airways of the mine is under the same pressure as that in the goaf, there is no tendency for the latter to flow into the former once the condition of equilibrium has been attained, whether this be under a *régime* of high or of low barometric pressure. A rapid fall of the barometer would necessarily affect the airways first, and would therefore cause the foul air from the goaf to flow out into the airways of the mine, and it is quite conceivable that a series of rapid alternations of high and low pressure, bringing about a considerable interchange between the air in the roadways and in the goaf, would promote diffusion, and thus help to increase the proportion of firedamp in the airways; in the main, however, it is the falling of the barometer that will bring about this result. This reasoning, based upon elementary physical laws, appears to be incontrovertible, and points conclusively to a falling barometer as the condition to be dreaded, and that this is the case is well known to all mining engineers, and apparently to everyone except the Press Association. It seems probable that the firedamp of the goaf plays a greater part in fouling the air of a mine than does that evolved from the coal, as a general rule, and that therefore a rapidly falling barometer is more dangerous than a continuously low barometer in most cases.

Numerous observations have abundantly confirmed this reasoning; the Prussian and Austrian Firedamp Commission showed conclusively that the percentage of firedamp in the air of mines was greater when the barometer fell, and the British Commission of 1886 came to the same conclusion, though they attached less importance to the subject; it may be advisable to quote their words:—"While we recognise that variations of atmospheric pressure exert influence on the escape of gases which have accumulated in the cavities, and possibly to a slight extent on that of gases emitted directly from the coal, we entertain great doubt as to the wisdom of placing reliance on the issue of meteorological warnings."

In addition to the work of the various commissions, there are in existence numerous reports of investigations carried on in this country and on the Continent, notably in Westphalia and the north of France, and all agree in showing that an increase of firedamp in the air of mines attends a fall of barometric pressure. It is thus inexplicable why the Press Association should still continue to look upon a high barometric pressure as a source of danger, unless on the reasoning that a high barometer must fall before very long, and it may be charitably assumed that the warnings are issued on this hypothesis. Nevertheless, the statement of the recent Royal Commission on Mines respecting these warnings (second report of the Royal Commission on Mines, 1909, p. 175):—"They are misleading, and, as far as we can see, their publication serves no useful purpose," deserves most emphatic endorsement.

Seeing that a barometric change cannot, of course, *per se*, bring about a colliery explosion, but can only produce conditions under which an explosion is liable to occur, the explosion itself being determined by the coincidence of several more or less accidental circumstances, it is hardly to be expected that statistics of explosions would be of any great value. In order, however, to get as much light as possible upon the facts of the case, I tabulated some time ago all the explosions that occurred in the year 1905, and compared them with the state of the barometer at Kew; parenthetically, I may remark that I took the Kew readings because the news agency bases its warnings upon it, although it is, of course, the state of the local barometer and not of the Kew barometer that really affects the question. The results were as follows:—

Out of 138 explosions there were:—

21 explosions when the barometer stood between	29·0 and 29·49 in.	
56	,, ,, ,,	29·5 ,, 29·99 ,,
54	,, ,, ,,	30·0 ,, 30·49 ,,
7	,, ,, ,,	30·5 ,, 30·8 ,,

Furthermore, there were:—

48 explosions when the barometer was	rising
70 ,, ,, ,,	falling
20 ,, ,, ,,	steady or slightly fluctuating.

I also compared the colliery warnings issued in the first half of 1905 with the explosions that took place. There were in those six months 62 days on which explosions took place out of about 155 working days, so that if a date should be selected at random, the probability that an explosion would occur on that day or the day following would be about 4 to 1; during those six months there were fifteen warnings issued, only six of which were followed within forty-eight hours by an explosion, so that the Press Association only hit upon a dangerous date once in less than ten times. Obviously it could do better if it trusted to chance alone, and if the matter were not such a serious one, I should be tempted to advise the newspapers concerned to turn over the subject of colliery warnings to their sporting tipsters. Over a series of years the average number of explosions was about 150 per annum, and the average number of warnings about 25, so that even if every warning were followed by an explosion, only one explosion in six would have been foretold.

Of course, it is every explosion that must be taken into account, and not only serious explosions or those attended by loss of life. Whether a small gas explosion occurs doing no damage at all, or whether the explosion extends throughout the whole of a colliery, killing its hundreds, is obviously determined by the circumstances of the case, and is independent of barometric fluctuations; indeed, modern researches are forcing us very near to the conclusion that in present-day colliery practice every serious extensive explosion is a coal-dust explosion rather than a gas explosion, though the latter may, and very often does, originate it. In fairness to the news agency, I may point out that when the barometer is high there is a likelihood that the coal-dust in a mine may be drier than when it is low, and it is possible, though not proved, that in these circumstances the risk of a coal-dust explosion may be somewhat greater. This consideration, however, does not affect the general conclusion that the colliery warnings as issued by the Press Association, which pointedly refer to firedamp, are misleading, and would be harmful but for the fact that most colliery managers know too much about the subject to pay any attention to them.

I hold that it would be a real service to the mining community if the Meteorological Office would send out notice whenever an area of considerable barometric depression is approaching our shores as long in advance as possible, so as to warn colliery managers to be on the look out for a fall in the barometer.

I understand that similar predictions are furnished to farmers at harvest time for a small fee, and surely if this can be done where material interests alone are involved, it is not too much to ask for the like assistance where men's lives are at stake. It is not at all certain that the influence of barometric changes upon the possibility of colliery explosions is of any great importance, but in matters of such supreme gravity, no precaution, however trifling, should be neglected.

HENRY LOUIS.

SOURED MILK AND ITS PREPARATION. LACTIC CHEESES.

IN a former article[1] the nature, preparation, and uses of soured milk were dealt with. It was pointed out that the consumption of sour milk is widespread in the East, that in all the sour milks a peculiar micro-organism is present, with artificial cultures of which it is possible to prepare soured milk in imitation of the natural product, and that soured milk tends to lessen intestinal putrefaction and seems to be beneficial in many complaints. The micro-organism (*Bacillus bulgaricus*) present in all the natural sour milks is one possessing distinct and special characteristics, though exhibiting marked variation or "pleomorphism," and Makrinoff,[2] who has critically studied the question, believes that all the varieties which have been described are referable to one species. Two more or less distinct *races* seem to exist, namely, one that produces a somewhat viscous product, another that does not, and for the preparation of soured milk the latter is to be preferred as yielding a more palatable product. The morphological and staining characters of the *Bacillus bulgaricus* are so distinctive that

FIG. 1.—Film of properly soured milk, showing presence of the *B. bulgaricus* only (Gram, ×1200).

a microscopical examination, combined with the Gram staining process, of the soured milk, enables us to judge to what extent the *B. bulgaricus* has developed, and whether there is contamination with other organisms (Figs. 1 and 2).

For the preparation of soured milk it was pointed out that the milk must be properly sterilised by adequate boiling, inoculated with a proper "starter," that is a culture of the *B. bulgaricus,* and incubated for from 12 to 24 hours at a temperature of 105° to 110° F. Starters may be obtained in the liquid and solid (tablet) forms, but unquestionably the liquid are far superior to the solid ones. Thus Quant[3] examined certain tablet preparations, and compared them with a liquid culture as regards flavour of, and production of lactic acid in, the soured milk produced. The liquid culture produced 2·34 per cent. of lactic acid *B.P.*,[4] the tablets yielded only 0·07 to 0·42 per cent. of lactic acid *B.P.*; moreover, the curd and flavour were unsatisfactory with the latter. Quant also

1 NATURE, April 7, 1910, p. 159.
2 *Centr. f. Bakt.*, Abt. ii., Bd. xxvi., 1910, p. 374.
3 *Brit. Med. Journ.*, 1909, ii., p. 1738.
4 *B.P.* = British Pharmacopœia.

directs attention to the importance of a proper incubation temperature. He found, using the liquid culture, that the yield of lactic acid at 105° F. was more than one and a half times that at 85° F., and more than one and one-third times that at blood heat, 98·4° F. Samples of five preparations were also examined for the *British Medical Journal*[1] with the following results:—

Percentage of Lactic Acid Produced.

Sample	After 10 hour's incubation
(1) Fluid culture (Oppenheimer)	0·96
(2) Fermenlactyl tablets	0·00
(3) Lactobacilline ,, ...	0·02
(4) Sauerin ,, ...	0·07
(5) Trilactine ,, ...	0·27

From this table it will be seen that the liquid culture is far superior to the tablets. The writer also examined[2] liquid sauerin, and sauerin, trilactine, and fermenlactyl tablets, and of these the liquid sauerin alone could be considered satisfactory.

In response to a request by the editor, several firms have been good enough to furnish preparations which

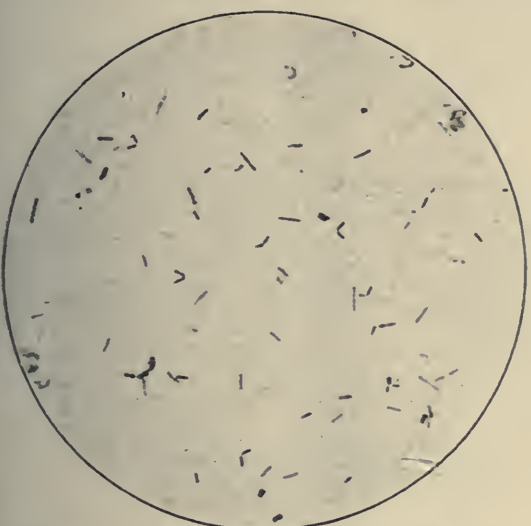


Fig. 2.—Film of soured milk prepared with tablet starter. Numbers of small Gram-negative bacilli present (Gram and eosin, × 1200).

have been examined by the writer with the following results:—

I. Content of *B. bulgaricus*:—

(1) *Tablets.*

(*a*) *B. bulgaricus* present in 1/100 and 1/1000 of a tablet, not in less. Streptococci also present.

(*b*), (*c*), (*d*) Very few *B. bulgaricus* present, even in 1/100 of a tablet; milk not curdled.

(2) *Fluid Culture.*

(*a*), (*b*), and (*c*) *B. bulgaricus* present even in 1/100,000,000 c.c. No streptococci.

(3) *Tablets.*

(*a*), (*b*), and (*c*) Very few *B. bulgaricus* present even in 1/100 of a tablet; milk not curdled.

(4) *Lactic Cheese.*

B. bulgaricus present in 1/100,000 gram, not in less. Streptococci present.

(5) *Sour Milk Cream Cheese.*

B. bulgaricus present even in 1/100,000,000 gram. Streptococci present.

From this it will be apparent that the fluid preparation (No. 2) has a content of *B. bulgaricus* enormously greater than the tablet preparations (Nos. 1 and 3). The lactic cheeses, if fairly fresh, contain a high content of *B. bulgaricus*, and are a pleasant and wholesome addition to the diet.

II. Characters of soured milk made with the preparations:—

(1) *Tablet.*—Milk markedly curdled. Acid, but somewhat cheesy odour. *B. bulgaricus* present in moderate number, also streptococci. Gram-negative bacilli present.

(2) *Fluid Culture.*—Milk well curdled. Acid, pleasant odour. Abundance of *B. bulgaricus*; no other micro-organism.

(3) *Tablet.*—Milk curdled, but *B. bulgaricus* scanty. Gram-negative bacilli present.

The result of these tests is to show that the tablet preparations do not produce a satisfactory soured milk, and the product is contaminated with bacilli other than the *B. bulgaricus* (see Fig. 2). The fluid culture, on the other hand, yielded an excellent soured milk, the flavour of which, however, would probably be improved if lactic streptococci were present in addition.

Special lactic acid-producing streptococci (*e.g. S. lebenis*) are always present in the natural sour milks, they aid the rapid growth of the *B. bulgaricus* by producing an acid environment, they tend to lessen the separation of the curd, and, in the writer's opinion, render the soured milk more palatable.

The small content of *B. bulgaricus* present in dry tablet preparations renders these comparatively inefficient for internal administration, and not to be compared with the ingestion of even a few cubic centimetres of properly soured milk.

I am indebted for the photomicrographs to Mr. J. E. Barnard.

R. T. Hewlett.

1 Brit. Med. Journ., 1909, i., p. 104.
2 Brit. Med. Journ., 1910, ii., p. 1584.

THE BRITISH SCHOOL AT ATHENS.[1]

The fifteenth volume of the "Annual of the British School at Athens" is somewhat less in bulk than its immediate predecessor. Probably its present length is about the extreme of what is convenient for a book of this format. The most important articles, as before, are those which describe the continuation of the work of the school at Sparta, which has been so successful, and has conferred such great distinction upon British archæology in Greece. Mr. Dawkins, the director, describes the work generally, and the conclusion of the excavation of the sanctuary of Artemis Orthia, and Mr. Droop the pottery, with regard to which he has made important discoveries which have given us quite a new idea of the history of ceramic art in the Peloponnese. The long list of inscriptions recovered in the sanctuary of Artemis Orthia is finally disposed of by Mr. A. M. Woodward, who appends to his admirable and painstaking work a series of corrections of re-discovered inscriptions which had previously been copied by Fourmont.

The main part of this section of the "Annual" is devoted to the description of the Menelaïon, the *heroön* of Menelaos and Helen, of whom the latter, at any rate, seems to have been originally a minor deity, a nature-goddess, akin to Artemis Orthia herself. The shrine is placed on a hill a little to the south of Sparta, and was solidly built on a strong revetment-wall of great stone blocks, to which the top of the hill serves as a core. This imposing work is probably of the fifth century B.C., but the explorers found many traces of far older occupation, going back to the Mycenæan period.

A large number of smaller antiquities were dis-

1 "The Annual of the British School at Athens." No. xv. Session 1908–9. Pp. viii+412+20 plates. (London: Macmillan and Co., Ltd., n.d.) Price 25s. net.

covered, mainly small votive offerings, consisting chiefly of figurines of terra-cotta and lead. These leaden figures are extremely interesting, and are well published in a series of plates. Those of warriors are

FIG. 1.—A Laconian Vase of the Seventh Century. From "The Annual of the British School at Athens."

of remarkable interest, as showing Spartan military dress from the seventh century onward. Small ornaments of lead, such as little spiked wreaths, were found in enormous numbers; Egyptian scarabs were found; of these one, pl. viii., Fig. 4, is published upside down. These are of the seventh century, as also is a ring (Fig. 12, p. 142).

The work at the Menelaïon is described by Messrs. Wace, Thompson, and Droop. Sandwiched between this and the preceding descriptions is a curious note on a Scottish parallel to the Spartan custom of electing the dead Lycurgus as eponymous *Patronomus*; in 1547 St. Giles himself was elected patron provost of Elgin for "ane zeyr nyxt to cum." This note, which is by Mr. P. Giles, seems a little incongruous in the prominent position which it occupies, and would have been better as a footnote somewhere else.

Messrs. Wace and Hasluck continue their interesting notes on the topography of Lakonia, and Mr. Traquair describes the notable churches of western Mani. The revival of church building by the always independent Maniotes at the end of the eighteenth century is interesting; it seems probable that this was largely due to the Greek cruise of the Russian squadron of Orlov, which revived the hopes of Orthodox Christendom for freedom from the domination of Islam. Mr. Hasluck continues his researches into the byways of Greek history during the Frankish period with his articles on "Monuments of the Gattelusi" (the Genoese lords of Aenos on the Maritza) in the Ægean, and on "Frankish Remains at Adalia," and also deals with "Albanian Settlements in the Ægean Islands." We return to the classical period with Mr. Woodward's article on a new fragment of an Athenian "Quota-List of the year 417–6 B.C.," giving the amounts paid by the subject-allies to the treasury of the Confederation of Delos in that year, and with Dr. Duncan Mackenzie's interesting reconstruction of figures in the East Pediment of the Temple of Ægina, in opposition to the views of the late Prof. Furtwängler. Dr. Mackenzie has, we are sorry to say, held over the next instalment of his long article on "Cretan Palaces," which has been a feature of recent volumes of the "Annual." Messrs. Wace and Thompson also contribute a short article on their discovery of "A Cave of the Nymphs on Mount Ossa," previously unknown. A large number of fragmentary votive *stelae* were found.

The third portion of this year's "Annual," and not the least important, also deals with Greek religion. This is the publication by Profs. Bosanquet and Gilbert Murray of the Hymn to the Kouretes, the warrior guardians of the infant Zeus, who, like the Salii of Rome, with whom they were compared long ago, leapt in their dance with clashing of sword and spear. In the hymn, which was discovered during the excavations of the school at Palaikastro, in Crete, the worshippers of Zeus pray the god to leap as did the Kouretes around him when a babe, as a ritual act to bring prosperity and good fortune to Crete: "To us also leap for full jars, and leap for fleecy flocks, and leap for fields of fruit, and for hives to bring increase. Leap for our cities, and leap for our seaborne ships, and leap for young citizens and for goodly law." So Prof. Murray admirably translates the Greek of the hymn. The march and dance of the Kouretes and the Salii remind one greatly of the leaping March of the Minoan "Harvesters," as they are called, on the steatite vase found by the Italian excavators at Agia Triada, in Crete, some years ago, of which a cast may now be seen in the British Museum. Are we to see in them Kouretes, or rather the young men performing the parts of Kouretes, as Strabo describes them as doing, in the mysteries of Zeus, with an older man as their leader? The curious implements which they bear will then be of an agricultural nature, since, as Prof. Murray

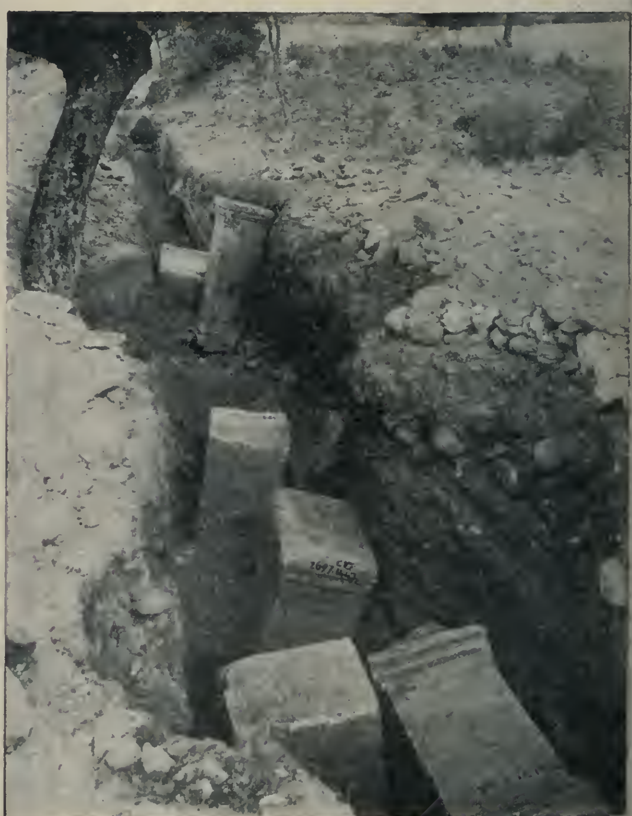


FIG. 2.—The re-discovered inscriptions in the Shrine of Orthia. From "The Annual of the British School at Athens."

observes, the Kouretes "were certainly connected with spring and fertility" (p. 360), but developed later into weapons, which Prof. Savignoni and the Italian archæologists first took them to be. I am, at the

moment of writing, uncertain whether or not this comparison has been made before.

The restoration of the text of the hymn and the translation by Prof. Murray is very interesting. I speak under correction, but is παγκρατὲς γάνους really to be rendered by "Lord of all that is wet and gleaming"? Why should Zeus Kouros be lord of all that is "wet and gleaming"? Why not "bright and Gleaming"? Though no doubt γάνος gives, strictly, the idea of "wet and gleaming," yet surely the reference is to the gleaming ripple of the cornfields, not to the sea?

Of the admirable character of the translation a specimen has been given above.

The myth of the Kouretes in its anthropological aspect is dealt with by Miss Jane Harrison, who treats it with her usual learning and wealth of illustration. Her conclusions are important, as bringing the dance of the Kouretes into connection with the initiatory rites at adolescence which are common among savage tribes; she aptly compares them with the initiation ceremonies in use among the Wiradthuri tribes of New South Wales. The scent on the Agia Triada vase derives a new significance from this comparison.

The director contributes a scheme for the transliteratia of modern Greek, which is to be used in future by contributors to the "Annual," with the exception that η is to be transliterated by *e* and not by *i*. This seems rather too great a concession to the weaker brethren; it gives an entirely wrong impression of the pronunciation to those who are accustomed to the values of *e* and *i* in foreign words.

The volume is one of the most interesting that the school has produced, although for the first time we miss in it any description of Minoan or Mycenæan discoveries. But the resumed excavations at Phylakopi, in Melos, which are now to be taken in hand, will no doubt enable the School to contribute again very shortly important material for the study of prehistoric Greece.

H. R. HALL.

KOREAN METEOROLOGY—OLD AND NEW.[1]

FOR the last six years a meteorological observatory, equipped with modern instruments, has existed at Chemulpo, and has been working energetically to establish a network of stations, from which the climatic elements of the country might be derived. Many difficulties have been encountered, but that these have been successfully overcome is shown by the issue of the first volume of scientific memoirs from the observatory, in which the director, Dr. Y. Wada, describes the progress that has been made and sketches the programme it is proposed to follow. He is to be congratulated upon the success of his vigorous direction, for a map shows that forty-five stations have been furnished with instruments, from which reports are received regularly. Most of these stations are scattered round the coast, at lighthouses, but there is also a chain of observatories running through the interior, and these no doubt will be increased as the country progresses.

A paper by Dr. T. Hirata shows that discussion proceeds simultaneously with the collection of observations. He investigates the amount of evaporation in Korea and South Manchuria, and its relation to precipitation. Although the data at present are slender, and the conclusions somewhat precarious, the inquiry is one of great economical importance, because the quantity of rain is barely sufficient to ensure the safety of the rice harvest on which the welfare of the country largely depends, and all information connected with moisture is of deep significance.

But as such inquiries have only a local interest and would fail to attract attention, Dr. Wada has done

FIG. 1.—Old Raingauge in Taiko.

well to quicken curiosity by reference to the science that flourished in the Korea of the past. He shows that the raingauge, supposed to have been invented by Castelli, about 1639, was in use in the East long before its value was appreciated in Europe. Dr. Wada, quoting from the second volume of the historical annals, explains that in the sixth year of the reign of King Sejo (corresponding to 1442 in the Gregorian Calendar), the King had a bronze instrument constructed to measure the rainfall. It was a vase of a depth of 30 cm. and a diameter of 14 cm. Every time rain fell, observatory officials measured the height and informed the King. But the important point in this account is, that this was not a toy set up from curiosity, but that similar instruments were distributed throughout the provinces, and the results of all observations were reported to the court. Naturally

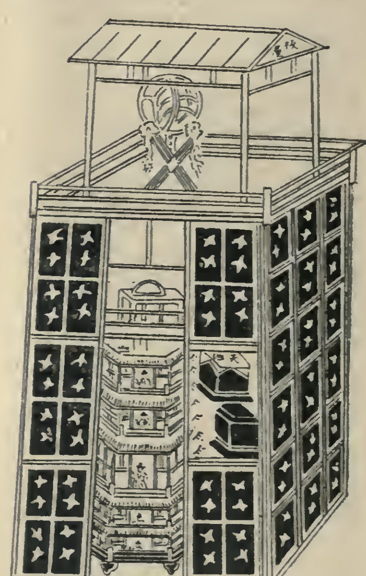


FIG. 2.—A Chinese Clepsydra of about 820 years ago.

[1] "Scientific Memoirs of the Korean Meteorological Observatory." Vol. i. Chemulpo, Korea, 1910.)

the director has endeavoured to recover specimens of these instruments and also the register of observations. Unfortunately, he has found no records and none of the original vases. But he has unearthed three copies of the pluviometer. The illustration reproduced here (Fig. 1) shows the instrument with the pedestal on which it stood. This instrument dates back to 1770. The three large Chinese characters declare that it is an instrument to measure rain, and the seven smaller give the date of its construction, in Chinese reckoning. Several pillars have been found without pluviometers attached, and one is particularly interesting, as a long Chinese inscription is engraved upon it, and though some of the characters have been obliterated by time, enough remains to connect it with the original order of King Sejo.

This same king erected astronomical observatories and fitted them with excellent instruments for the time. He seems to have prided himself on the possession of an automatic clepsydra, in which the hours and quarters were sounded by manikins. The general form of clepsydra seems to have consisted of four vessels at different levels, "and water poured in the highest vessel flows, passing through the intermediate ones, into the lowest, where an arrow with graduations to indicate the time in its upper part, was floated." Fig. 2 gives the general form of the instrument, but the mechanism is not well shown. Dr. Wada also reproduces a photograph of an ancient observatory, demonstrating the forward state of science of the age, about 647 A.D. It is supposed to have been used for the making of observations to correct the calendar, but there is nothing in the picture to suggest that it ever formed part of an observatory. It is simply a tower-like structure.

THE ADMISSION OF WOMEN TO THE FRENCH ACADEMIES.

WE learn from the *Times* of January 5 that at the recent quarterly plenary meeting of the five academies of the French Institute, the question of the eligibility of women candidates for the institute came up for consideration. It arose from the circumstance that Mme. Curie, the discoverer of radium, has been put forward as a candidate for one of the vacant seats in the Academy of Sciences. How her claims are regarded by that body may be inferred from the fact that in the list as finally submitted her name stands at the head. It is stated that at the general meeting more than 150 academicians were present, and that the proceedings, as might have been expected, "were extremely animated." Eventually the motion in favour of the admission of women was rejected by 90 votes to 52. The institute further adopted a motion to the effect that whilst it did not presume to dictate to the separate academies, there was, in its opinion, "an immutable tradition against the election of women, which it seemed eminently wise to respect."

It remains to be seen what the Academy of Sciences will do in face of such an expression of opinion. Mme. Curie is deservedly popular in French scientific circles. It is everywhere recognised that her work is of transcendent merit, and that it has contributed enormously to the prestige of France as a home of experimental inquiry. Indeed, it is not too much to say that the discovery and isolation of the radio-active elements are among the most striking and most fruitful results of a field of investigation pre-eminently French. If any prophet is to have honour in his own country—even if the country be only the land of his adoption—surely that honour ought to belong to Mme. Curie. At the moment, Mme. Curie is without a doubt, in the eyes of the world, the dominant figure in French chemistry. There is no question that any man who had contributed to the sum of human knowledge what she has made known, would, years ago, have gained that recognition at the hands of his colleagues which Mme. Curie's friends are now desirous of securing for her. It is incomprehensible therefore, on any ethical principles of right and justice, that because she happens to be a woman she should be denied the laurels which her pre-eminent scientific achievement has earned for her.

There may be room for difference of opinion as to the wisdom or expediency of permitting women to embark on the troubled seas of politics, or of allowing them a determinate voice in the settlement of questions which may affect the existence or the destiny of a nation; but surely there ought to be no question that in the peaceful walks of art, literature, and science, there should be the freest possible scope extended to them, and that, as human beings, every avenue to distinction and success should unreservedly be open to them.

All academies tend to be conservative and to move slowly; they are the homes of privilege and of vested interest. Some of them even incline to be reactionary. They were created by men for men, and for the most part at a time when women played little or no part in those occupations which such societies were intended to foster and develop. But the times have changed. Women have gradually won for themselves their rightful position as human beings. We have now to recognise that academies as seats of learning were made for humanity, and that, as members of the human race, women have the right to look upon them as their heritage and property no less than men. This consummation may not at once be reached, but as it is based upon reason and justice it is certain to be attained eventually.

NOTES.

AN earthquake of unusual violence occurred in Russian Turkestan at 1.25 a.m. on January 4, or shortly after 11 p.m. on January 3 (Greenwich mean time). At Vyernyi, the chief town of the district, with more than 11,000 inhabitants, the shock lasted for nearly five minutes, and has been succeeded by a large number of after-shocks. Nearly every building in the town is damaged, and all the mud-houses in the neighbourhood have collapsed. The total loss of life is unknown, but forty bodies have so far been recovered from the ruins. It is reported that the whole of the town of Prjevalsk, which is situated on the shores of lake Issik Kul, has been destroyed by the waters of the lake. The extraordinary violence of the earthquake is attested by its effects on the seismographs of distant observatories. At Pulkova, more than 2200 miles from the epicentre, practically all the instruments were thrown out of order. This was the case even in this country. At West Bromwich, the first tremors were recorded at 11.35 p.m., and soon attained a range of 15 mm. By 11.54 the range was far beyond the capacity of the instrument, and at midnight the east-west needle collapsed. The great movement continued until 12.12 a.m., and the disturbance did not end until 3.56 a.m., giving a total duration of $4\frac{1}{4}$ hours. At Cardiff the maximum movement was registered at 12.14 a.m., and was so great that the instrument was deranged. At Limerick all the instruments were dismounted. The earthquake, which is one of the greatest of the last quarter of a century, is evidently a successor of that which occurred on June 9, 1887, when Vyernyi suffered even greater injury than on the recent occasion, owing to the prevalence of stone buildings, which have since been largely replaced by wooden ones.

We regret to see the announcement of the death, on January 10, of Mr. J. W. Tutt, whose work in entomology and other departments of natural history are known to many men of science. Mr. Tutt was trained as an elementary-school teacher at St. Mark's College, Chelsea, and was at the time of his death headmaster of the Portman Place Higher Grade School. He became a Fellow of the Entomological Society of London in 1885, and was a member of its council. He was also prominently associated with other entomological and natural history societies in the City and South London, and was honorary member of La Société Entomologique de Namur and La Société Entomologique de Genève. He was editor of the *Entomologist's Record* as well as of the *South-Eastern Naturalist*, and the author of numerous papers and other publications of substantial scientific value, including "A Natural History of British Lepidoptera," "A Natural History of British Butterflies," "A Natural History of British Alucitides," "Migration and Dispersion of Insects," "Melanism and Melanochroism in British Lepidoptera," "British Noctuæ and their Varieties," "Monograph of the British Pterophorina." Mr. Tutt also wrote a number of works on the more popular aspects of natural history, and in many ways contributed to the advancement and extension of scientific knowledge.

We record with regret the death, on January 6, of Sir John Aird, at the age of seventy-seven years. Sir John Aird's name will be associated by most people with the erection of the Assuan dam and the Assiut barrage. With his partners he was the builder of the Manchester Ship Canal. He was also actively engaged in many other great engineering undertakings, which include, among others, waterworks at Amsterdam, Calcutta, Copenhagen, London, and Birmingham; the docks at Tilbury, Southampton, Avonmouth, and Singapore; the West Highland Railway and the Hull and Barnsley Railway; and gas plants on a large scale in many parts of the world. Sir John Aird was elected an associate of the Institution of Civil Engineers in 1859, and a member of the Iron and Steel Institute in 1887. He was created a baronet in 1901.

The French Prehistoric Congress is to be held at Nîmes on August 13–20 of this year.

The French Society of Therapeutics has awarded its gold medal to M. Ch. Moureu, for his work on the rare gases and the radio-activity of French mineral waters.

Mr. F. M. Bailey, Colonial Botanist, Queensland, and Mr. G. H. Knibbs, Commonwealth Statistician, Commonwealth of Australia, were included among the new C.M.G.'s in the list of New Year Honours. We regret their names were omitted from our note last week.

By the generosity of Dr. Charcot, the *Pourquoi Pas?* has become the property of the French Department of Public Instruction. The vessel is anchored off Rouen, and is attached to the Paris National Museum of Natural History. An annual grant of 10,000 francs, we learn from the *Revue scientifique*, has been made towards the upkeep of the ship, which will be utilised by the museum for oceanographical cruises.

The Christiania correspondent of the *Morning Post* states that more than a hundred distinguished Norwegians, including the Prime Minister, the Ministers for Foreign Affairs, Public Works, and Commerce, and the Rector of the University, gave a banquet on January 7 in honour of Dr. S. Eyde, the well-known engineer, who has done so much towards the development in Norway of the industry based upon the fixation of atmospheric nitrogen.

We learn from the *Chemist and Druggist* that the late Dr. Ernest Durand, known as the donor to the Paris Museum of Natural History of the herbarium originally belonging to the botanist Cosson, has left the sum of 6000*l.* to be devoted to the classification and study of the botanical collections in the museum. At the time these collections were given to the authorities, in 1906, Dr. Durand gave 2000*l.* to defray the expense of classification, &c.

A meeting of the International Association of Seismology will be held in Manchester under the presidency of Prof. Arthur Schuster, F.R.S., beginning on Tuesday, July 18 next. The meeting will consist of delegates of the twenty-three countries belonging to the association, and other men of science who may be invited by the president. The president asks us to state that he will be glad to hear from anyone interested in the subject.

At a meeting on January 4, the Development Commissioners considered their policy in connection with agricultural instruction in England and Wales and in regard to the financial needs of the Scottish agricultural colleges, and decided upon the terms of a letter to the Scottish authorities. The Commissioners also decided to obtain, temporarily, scientific assistance for the investigation of the possibilities of the cultivation of tobacco and flax.

The arrival of several boxes of skins of mammals and other animals from Sze-chuen at the natural history branch of the British Museum affords the *Times*, in its issue of January 3, an opportunity of referring to the generosity of the Duke of Bedford in providing funds for collecting expeditions in northern China and other districts in the heart of Asia, these museum expeditions having been carried on for several years. Reference is also made to similar work which has been carried on for some time in Africa at the expense of Mr. C. D. Rudd. The latest of these expeditions is now at work in British East Africa.

On Tuesday next, January 17, Prof. F. W. Mott, F.R.S., will begin a course of six lectures at the Royal Institution on "Heredity," and on Thursday, January 19, the Astronomer Royal, Mr. F. W. Dyson, F.R.S., will deliver the first of three lectures on "Recent Progress in Astronomy." The Friday evening discourse on January 20 will be delivered by Sir James Dewar, F.R.S., on "Chemical and Physical Change at Low Temperatures"; on January 27 by Prof. W. H. Bragg, F.R.S., on "Radio-activity as a Kinetic Theory of a Fourth State of Matter"; and on February 3 by Dr. A. E. Shipley, F.R.S., on "Grouse Disease."

The council of the Rhodesia Scientific Association adopted the following resolution at a meeting held recently:—"That a gold medal be offered for an original paper advancing our knowledge of the transmission of any insect- or arachnid-borne disease affecting Rhodesia, such paper to be read at a meeting of the Rhodesia Scientific Association for publication in its Proceedings. The medal will only be awarded for a paper which, in the opinion of the council, is of sufficient scientific merit." Non-residents as well as residents in Rhodesia are invited to send in papers not later than July 31 addressed to D. Niven, Secretary Rhodesia Scientific Association, P.O. Box 586, Bulawayo.

The council of the Institute of Metals reports that a large increase has recently taken place in the membership of the institute, which now reaches more than 550. Addi-

tional honorary members have been appointed in the persons of Dr. R. T. Glazebrook, F.R.S., and Sir Andrew Noble, Bart., K.C.B., whilst Sir William H. White, K.C.B., F.R.S., has been elected the first fellow of the institute. The annual general meeting of the institute will be held on January 17–18. On the latter day, papers will be read at the Institution of Mechanical Engineers, Westminster, S.W., commencing at 10.30 a.m. Among the papers are the following:—A new critical point in copper-zinc alloys: its interpretation and influence on their properties, Prof. H. C. H. Carpenter; some practical experience with corrosion of metals, Engineer Rear-Admiral J. T. Corner, C.B.; the adhesion of electro-deposited silver in relation to the nature of the German silver basis metal, Prof. A. McWilliam and Mr. W. R. Barclay. There will also be presented the preliminary report to the Corrosion Committee, by Mr. G. D. Bengough. This report will be of an important character, dealing with the present state of our knowledge of the corrosion of non-ferrous metals and alloys, with suggestions for a research into the causes of the corrosion of brass condenser tubes by sea water. Full particulars regarding the institute can be obtained from Mr. G. Shaw Scott, secretary of the Institute of Metals, Caxton House, Westminster, S.W.

THE first annual meeting of the Astronomical Society of Barcelona was held on December 8, 1910, when the new president and executive council were elected. Addresses were delivered by the retiring president on the progress of astronomical science during the year 1910, and by the secretary on the development of the society since its foundation. The inaugural meeting of the society was held on January 30, 1910, at the University of Barcelona, as a result of the labours of Don Salvador Raurich, who had been carrying out valuable educational work in the city by means of popular articles on astronomical and allied subjects contributed to the columns of *Las Noticias*, a well-known Barcelona journal. At the inaugural meeting Dr. Esteban Terradas, professor of physics in the University of Barcelona, was elected first president, and a strong executive council was formed. In April King Alphonso became a life member, and was elected honorary president. At the present time the membership numbers 230, and as a result of the first year's work the society finds itself with a bank balance of 80*l.* after paying all expenses. In the future it is intended to devote the accumulated funds of the society to the erection and equipment of an observatory, where members may meet regularly in a social way for practical observation and the informal discussion of questions of astronomical interest. During the year lectures on astronomical subjects were delivered in the Grand Saloon of the University of Barcelona, and numerous addresses on a smaller scale were given on practical spectroscopy and general astronomy in the private observatories of certain members. The following is a list of the officers of the society for the year 1911:—*President*, Prof. Eduardo Fontseré, chief of the Time Service of Barcelona; *vice-presidents*, Prof. Luis Canalda and Don Ferdinand Tallada; *secretary*, Don Salvador Raurich; *vice-secretary*, Don A. Pulvé; *treasurer*, Prof. M. Font y Torné; *other members of the council*, Prof. Ignacio Tarazona, professor of astronomy in the University of Valencia; Dr. Enrique Calvet, Don José Subiranas, and Don Juan Mercadal. The address of the secretary is Diagonal, 462, Barcelona, where all communications should be addressed. The society is entering upon its second year of activity with bright prospects, and is very successfully cultivating a taste for astronomical study among all classes in Spain.

THE Research Defence Society has just published a small book called "The Truth about Vivisection." The book is a collection of leaflets dealing with some of the main points in the practice of experiments on animals, and of the results obtained by this means. It also includes a leaflet on the charges made against the Rockefeller Institute, and also the correspondence between the secretary of the Church Anti-vivisection Society and the Bishop of North Queensland. All the points dealt with are clearly explained, and technical details are avoided so far as possible. The book is therefore suitable for anyone to read, even if not conversant with the correct phraseology. This is a great advantage, because the details of the whole matter are naturally of a highly technical character. Much of the misapprehension which exists in the minds of many people, including those who are definitely anti-vivisectionists, arises from want of knowledge. In the great majority of cases this is not wilful, but simply because the details have hitherto been almost impossible for the uninitiated to follow. There are, however, a few persons to whom the words of Mr. Rudyard Kipling are applicable. He says that there will always be persons "who consider their own undisciplined emotions more important than the world's most bitter agonies—the people who would limit and cripple and hamper research because they fear that research may be accompanied by a little pain and suffering." It is very desirable that all thinking people should endeavour to acquaint themselves with the essential facts of the case, and the recent publications of the Research Defence Society have now made this possible by providing the necessary information in a simple form. The leaflets show that 95 per cent. of the experiments performed are of inoculations, which are not really in any way an operation, being merely needle-pricks. A great number of these are routine investigations carried out on behalf of various Government departments for the preservation and improvement of the public health. The history of the successful fight against Malta fever and other tropical diseases forms a chapter of intense interest in the history of the British Empire, and is one which well repays study; this side of the question might with advantage be somewhat further developed in the collection of pamphlets in question. The little book is highly to be recommended, and should supply a great want.

IN a report contributed to the December (1910) issue of *Man* on the Ceylonese drum known as *udakiya*, Dr. A. Willey connects this hour-glass pattern of instrument with certain drums made from human skulls found in Tibet. In the latter type the drum consists of two human *calvaria* inverted and superposed, the ends being covered with pieces of skin. The use of such drums for magical purposes is not uncommon in Tibet, and thence the shape may have passed to India, where it is still used by ascetics and spirit mediums, and thence to Ceylon. The custom which still prevails in Tibet of drinking from the skull of a holy man or an enemy is remotely connected with this form of drum.

IN the December (1910) issue of *Man* Messrs. E. T. Nicholle and J. Sinel describe the exploration of a Palæolithic cave-dwelling, known as La Cotte, at St. Brelade, Jersey. The existence of this habitation has been known since 1881, and it has now been investigated under great difficulties, due to its position. Bones of *Rhinoceros tichorhinus*, horse, reindeer, and deer, with human teeth and some fragmentary bones, have been unearthed. The flint implements, found in considerable numbers, belong to the well-known tongue-shaped Mousterien class, the

"pointe à main" of Mortillet. Falls of rubble have now rendered it impossible to make further examination of this site at present.

IN the Johns Hopkins Hospital Bulletin for December, 1910, there is an instructive article by Dr. Lewellys F. Barker on electrocardiography and phonocardiography, and containing many illustrations of the apparatus employed and of the cardiograms obtained. It is chiefly remarkable for the description of the electrocardiographic installation in the medical clinic of the Johns Hopkins Hospital, which shows that the apparatus may be fitted up at a smaller cost than is generally supposed, and that it may be applied to the diagnosis of a good many cardiac and nervous diseases. The remarkable progress in this department of clinical inquiry is well shown in this paper, and especially in the analysis of the many curious cardiograms obtained at Baltimore and elsewhere.

IN the Proceedings of the Royal Society, ser. B, vol. lxxxiii., p. 124, Dr. R. Kirkpatrick describes, under the name of *Murrayona phanolepis*, a new type of sponge from Christmas Island, Indian Ocean, referable to the family commonly known as the Pharetronidæ, equivalent to the Pharetrones of Zittel. When this group was first established, it was believed to be extinct, with its latest representative in the Mæstricht Chalk, but, inclusive of the new Christmas Island form, which constitutes a subfamily by itself, six living genera, each with a single species, are now known. Murrayona differs from all the other genera in that the skeleton consists of a firm basal network devoid of spicules, overlain by a dermal layer of scales, the axial core of spicules found in the other living genera having been discarded. The absence of spicules in some of the fossil Pharetrones may be due to the same cause, although in other instances (as has hitherto been considered to be the case with all) it may be the result of fossilisation. Apparently there is no such genus as Phareton, and if this be the case the family requires a new name.

THE two articles in the *Journal of Economic Biology* for December, 1910, are devoted to "warbles." In the first of these Prof. G. H. Carpenter furnishes notes on the life-history of the reindeer warble-fly (*Œdemagena tarandi*), his specimens being derived from a young reindeer in the Dublin Zoological Gardens. He finds that the egg of Œdemagena has a thin flap at the free end, along the edge of which the egg-case readily splits. The position and appearance of this recall the "lid" of the egg of the horse bot (*Gastrophilus equi*), and suggest that the maggots of Œdemagena are licked off and swallowed by the reindeer immediately after hatching. In *Hypoderma bovis*, the ox warble, the egg has no such lid, which lends support to the suggestion that the host swallows the eggs instead of the maggots. In the second article Messrs. Cooper and Nuttall, who accept the idea that cattle lick off the eggs of Hypoderma from their legs as a definite fact, discuss means of preventing the destruction of hides by warbles. A hide was cut into four quarters, of which three were severally treated with different chemicals, including picric acid, and it was found that in none of the cases was tanning interfered with. It is recommended that the experiment of treating the legs of oxen with picric acid should be tried.

THE current number of the *Quarterly Journal of Microscopical Science* (December, 1910) contains an elaborate and very interesting memoir, by Prof. J. P. Hill, on the early development of the Marsupialia, with special reference to the native cat (*Dasyurus viverrinus*). This forms the fourth of the author's well-known contributions to the embryology of the marsupials, and in it he describes in detail the process of cleavage, the formation of the blastocyst, and the differentiation of the embryonal ectoderm and endoderm. The uterine ovum possesses a shell-membrane and a layer of albumen outside the zona, analogous with the corresponding structures in the egg of monotremes, but is much smaller than the latter, and contains much less yolk, its condition in these respects being intermediate between that of the monotreme and that of the eutherian egg. The character of its early development is also intermediate between that of the two latter groups. Cleavage is complete, and at first meridional, resulting in the formation of a ring of eight blastomeres placed equatorially within the egg-shell, followed by an equatorial cleavage which divides each blastomere into two, an upper, smaller, and clearer, and a lower, larger, and more opaque. Two rings, each of eight cells, are thus formed, the upper one giving rise to the embryonal region of the blastocyst wall, and the lower to the extra-embryonal region, which the author regards as homologous with the trophoblast of the eutherian ovum. Prior to the completion of the first cleavage, the egg eliminates from itself a spherical mass of yolk which takes no direct part in development, though it becomes enclosed in the blastocyst cavity. The paper includes a valuable discussion of the early ontogeny of the Mammalia, in which the author defends the generally accepted view that the mammals are descended from ancestors which had large, heavily yolked eggs, and vigorously opposes the recently promulgated theory of Hubrecht, in accordance with which the alecithal character of the eggs of higher mammals represents the primitive condition. He also entirely disagrees with Hubrecht's interpretation of the trophoblast as an embryonic membrane comparable with that of the nemertines and other invertebrates. The "entypic" condition of the eutherian embryo is explained as a secondary modification due to the loss of the egg-shell.

A NOTE by Miss A. G. Stokey on the sporangium of *Lycopodium pithyoides*, published in the *Botanical Gazette* (September, 1910), indicates that the sporangium arises from the leaf, but during development grows away from it, and appears to be cauline. In size and shape, as well as in the proportion of wall cells, the sporangium resembles that of *L. dichotomum*.

THE annual report, for 1910, of the Department of Agriculture, Trinidad, by Prof. P. Carmody, covers the reports of the botanical departments in Trinidad and Tobago, of various estates, and the Government laboratories. The cacao exports for the year were the highest on record; crops of sugar-cane were good, but the sucrose content of the juice proved to be small. Analyses of Castilloa rubber trees of different ages showed that the latex in young trees contained more than 50 per cent. of resin, and this decreases to about 8 per cent. after eight or ten years.

A CYTOLOGICAL investigation of corn rust, *Puccinia graminis*, described by Dr. F. Zach in the *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften*, Vienna (April, 1910), deals with the crucial stage when the fungus invades the palisade cells of the leaf and enters upon a contest with the protoplasm and nucleus. Sometimes the fungus is worsted and its hyphæ are dissolved; in other cases the fungus is victorious, when the protoplasm and nucleus are disintegrated and certain portions are excreted. It is suggested that the power of the host to withstand the attack of the parasite is partly innate, but to a great

extent determined by climatic and soil conditions. The author criticises the mycoplasm theory of Eriksson, which refers mainly to the phenomena here described.

A CATALOGUE of hybrid plants raised at Kew during past years is published in the *Kew Bulletin* (No. 9). The three hybrid species of Cytisus are interesting, two being ascribed to chance pollination by insects, while the third, *Cytisus Dallimorei*, producing pale purple flowers, was the result of an artificial cross between a variety of *C. scoparius* and *C. albus*; it received an award at the Temple Show last year. Success has been attained with several Rhododendron hybrids, notably a cross from *Rhododendron Fortunei*, and two monophyllous Streptocarpus hybrids are recorded. A Strelitzia that flowered for the first time during the winter 1909–10 was raised from a cross made in 1893.

THE Agricultural and Forestry Department of the Nyasaland Protectorate has issued its second annual report, from which we learn that the past year has been one of the most successful on record. A few years ago the only industry of any importance was coffee; when this failed, the plantations were closed down. With the introduction of cotton, tobacco, and rubber, the area of land under cultivation has steadily increased, and at no time in the history of the protectorate have such large areas of virgin land been opened up for planting as at present. The experimental work of the department consists in the improvement of existing crops and testing of new crops likely to be of value. Afforestation is also being undertaken, the railway and tobacco industries having been responsible for a large consumption of the native timber.

THE *Agricultural Journal of India*, vol. v., part iii., contains articles on the cultivation of millet, jute, Caravonica cotton, and bananas. The millet, *Andropogon Sorghum*, is grown in the dry zone of Upper Burma, where the yearly rainfall is from 20 to 25 inches, and rice will not grow. The grain furnishes food for the natives, and the leaves and stalks for cattle. Jute is grown on land suitable for rice; in some districts it is possible to take winter rice after jute, and thus to get two crops in one year; but this is not always possible, and in general it may be said that the area under jute represents the loss of so much land to rice. Caravonica cotton is a hybrid tree cotton recently introduced, for which many excellent properties were claimed. It is stated, however, that the variety has not been a success, and, further, that no tree cotton is known that will answer as a field crop.

THE need for phosphatic manures in all parts of the world, and the rate at which their already high consumption is increasing, makes it important that all known phosphate deposits should be mapped as thoroughly as possible. Should a phosphate famine ever occur, it would be more serious than a coal or any other famine, as no substitute of any kind is known. The United States Department of Agriculture Bureau of Soils has recently investigated the phosphate fields of Idaho, Utah, and Wyoming, and published the results as Bulletin 69 of their series. The deposits are considerable, and though they are not yet extensively worked because of their distance from markets, there is no doubt that they will become important in future. It is recommended that steps should be taken now to control the mining rights and to prevent waste of the lower-grade deposits that will not at first be profitable to work.

PROF. EMILE CHAIX, Avenue du Mail, 23, Geneva, has issued a circular letter, accompanied by a pamphlet, directing the attention of geographers and geologists to the "Atlas photographique des formes du Relief terrestre." This work was organised by the ninth International Congress of Geography in 1908, in accordance with a proposal by Profs. Brunhes and Chaix, and subscriptions are now asked for, so that a series of views may be prepared and published. Prof. Chaix's pamphlet furnishes the details, and it will be possible to subscribe for 100 plates at half a franc apiece, or single plates at one franc each. It is estimated that the whole series required would be about 500 to 600 plates, their issue being spread over ten years. The samples furnished give a picture about 13 cm. by 9 cm., and are of a geological rather than a geographical character. The scheme, however, is a wide one, and we may hope to see such subjects as typical cirques, alluvial plains, and escarpments, illustrated from all parts of the world. It is at present, for example, difficult to obtain views of our own Cotteswold Hills, or the meanders of the Severn, or the Hercynian ridges of southern Ireland. The cooperation of scientific photographers is invited, and it is to be hoped that geographical considerations will prevail in the selection.

IN the meteorological chart of the North Atlantic Ocean for January (first issue), published by the Meteorological Committee, attention is directed to the displacement of the high-pressure system to the region of Madeira and North Africa as one of the marked features in the daily weather maps of December 8–14, 1910, embracing the North Atlantic and adjacent shores. An enormous region of low pressure, extending from Nova Scotia to the western half of Europe, is shown by the charts; on the morning of December 12 the barometer reading on board the *Mauretania*, in lat. 51° N., long. 21° W., was as low as 28.04 inches. A remarkable circumstance connected with several well-developed secondary disturbances which advanced in rapid succession towards Ireland was that none of their centres passed eastward of the Irish Sea. Under their influence, the weather conditions were of an exceedingly unsettled type all through the week.

THE flexure of a rectangular plate under uniform hydrostatic pressure is a problem which mathematicians have from time to time attacked by different methods. A new investigation, based on the methods of Mr. Walter Ritz, is now published by Mr. D. Pistriakoff, of the Kieff Polytechnic. It is published in Russian, with a short abstract in French.

THOSE mathematicians and physicists who experience difficulty in forming a clear mental picture of the concepts of non-Euclidian geometry will find a useful and suggestive paper on the Bolyai-Lobatschewsky system, by Prof. H. S. Carslaw, in the Proceedings of the Edinburgh Mathematical Society, xxviii. (1910). The author starts by showing how the properties of planes and straight lines in ordinary space can be extended by inversion to spheres and circles through a fixed point. He then proceeds to consider the properties of spheres and circles that are orthogonal to a given fixed sphere, and shows that if these be called "ideal planes" and ideal lines, they will be found to possess properties exactly analogous to those of hyperbolic geometry. In the plane geometry thus established "ideal parallels" are represented by circles which touch on the fixed orthogonal circle, and thus it follows that through a given ideal point two parallels can be drawn to a given line. In short, Prof. Carslaw shows that a geometry identical with that of Bolyai and Lobatschewsky can be built up in ordinary Euclidian space, and, so far as plane geometry is concerned, in an ordinary

Euclidian plane. Unless some unforeseen fallacy in this investigation should be discovered which has escaped Prof. Carslaw's notice, we have here a convincing proof that Euclid's parallel postulate is incapable of demonstration. In fact, it is argued that if any inconsistency existed in the Bolyai-Lobatschewsky postulate this inconsistency would be extended by Prof. Carslaw's "ideal" system to Euclidian geometry. Do not these arguments point to the view that Euclid's postulate should be regarded as a property of matter rather than of space?

In the *American Architect* for November 23 Mr. Wm. H. Goodyear describes measurements of 1910, undertaken on behalf of the Brooklyn Museum, of the spiral stairway of the Leaning Tower of Pisa. The main result of these measurements is to confirm the author's view that the inclination of the tower was intentional, and was not due to subsidence after or even during construction. The main evidence on this point is derived from an examination of the steps between the thirteenth and sixty-ninth. Not only does the mean height of the ceiling increase by 1 foot 10½ inches between the thirty-fifth and forty-ninth steps, but there is an increase in the downward dip of the ceiling to the inner wall of about 8½ inches in the whole interval. As the stairs in question represent the extremities of the line of greatest slope, the effect of these changes is to throw the weight of the structure off the overhanging side. On the higher floors these variations appear to have been abandoned, presumably on the ground that the safety of the structure was sufficiently secured without them, whereas if the inclination were accidental it is obvious that the tendency would be to increase the precautions as the subsidence increased. The author further points out the advantages from an æsthetic point of view of the standing of the Leaning Tower in a depression or "well," and also of the change of inclination of the upper storeys, both of which support the theory of intentional inclination of the structure.

The measurements of the magnetic properties of iron, steel, nickel, and cobalt at the temperature of liquid air, which have been made by Dr. R. Beattie and Mr. H. Gerrard, and were described in the *Electrician* for December 23, 1910, confirm the view generally held on the strength of results obtained at higher temperatures, viz. that decrease of temperature increases hysteresis. The curves given for the hysteresis losses as functions of the magnetic induction in alternating and in rotating fields are of the same general form at the temperature of liquid air as at ordinary temperatures. The loss in cobalt in a rotating field is about twenty times that in nickel. The authors make no reference to the Langevin-Weiss theories, but, so far as one can judge from the curves, their results do not furnish any material support for those theories.

Vol. iii. of the Journal of the Municipal School of Technology, Manchester, consists of nearly four hundred pages of reprints of papers communicated by the staff and students to scientific societies and to the technical Press during the year 1909. The principal papers deal with mechanical and electrical engineering and with chemistry, and show that in these subjects, at least, the Manchester School stands in a position which no other technical school or polytechnic in the country has approached. Of the thirty papers, two may be selected as typical of the work the school is doing. The first, by Prof. Nicholson, deals with experiments directed to the removal of the obscurity which enveloped the subject of the transmission of heat from the furnace gases to the water in a steam boiler, and some of the results obtained have already been incorporated in boiler design. The second, by Prof. Knecht and Mr. J. P. Batey, contains the results of examinations of a number of dye-stuffs in solution in order to settle the question whether these substances exist in solution as colloids or not. The authors conclude that the dyes tested do not. These examples serve to show how successfully the Manchester School of Technology is bringing the power of science to bear on the industries of which Manchester is the centre.

An interesting article on photo-elasticity, by Prof. E. G. Coker, appears in *Engineering* for January 6. Account is given of apparatus and experimental results obtained at Finsbury Technical College, the experiments having for their object the determination of the condition of stress in transparent bodies by the effect which these latter, when subjected to such stresses, produce on polarised light passed through them. A special optical bench designed by Mr. F. Cheshire is used, in which a lantern, fitted with an arc lamp, projects a beam of parallel light. The beam is polarised by a Nicol's prism, then passed through the specimen, which latter is stressed by some convenient apparatus. A lens focuses the beam on a second Nicol's prism, which serves as an analyser, and the image of the specimen so formed is thrown on a screen or sensitive plate. A feature of the article is the reproduction in colours, by the three-colour process, of a large number of photographs taken on Lumière plates direct from the specimens under stress. These are of special interest to engineers, and include examples of beams, tension members, a furnace flue, circular hooks and chain links, a locomotive plate spring, a square threaded screw and nut, and a pillar. Examples are included showing the disturbance in the stress distribution caused by notching the specimens in various ways, and also the effect of a non-axial load on a tension member. Probably glass is the material possessing properties most closely resembling materials in general use by engineers, but, owing to the difficulty of preparing glass specimens, xylonite has been used.

Mrs. H. Periam Hawkins sends us a copy of a new (the fourth) edition of "The Stars from Year to Year," in which the account of Halley's comet, to which reference was made in the notice of the book in last week's Nature (p. 304), is brought up to date. We do not quite understand why the earlier edition should have been sent to us for notice when a new edition was to be issued a few weeks later.

The current quarterly issue of Mr. C. Baker's catalogue of second-hand instruments for sale or hire has reached us. Particulars are given of more than 1500 pieces of scientific apparatus which can be bought or hired at the second-hand department at 244 High Holborn, London. From the same house comes a very complete list of additions since 1909 to the stock of lantern-slides of scientific interest.

Mr. Edward Stanford announces for publication on January 16 the third edition, rewritten and enlarged, of "The Building of the British Isles," by Mr. A. J. Jukes-Browne. It is eighteen years since the last edition of this work was issued, and much fresh matter has consequently been embodied in the new book.

In the paragraph relating to the "Live Stock Journal Almanack" in Nature of December 29, 1910, the name Lord William Cecil should have been Lord Arthur Cecil.

OUR ASTRONOMICAL COLUMN.

THE JANUARY METEORS.—Mr. W. F. Denning writes:—"The night when the shower of Quadrantids or Boötids was expected proved very clear at Bristol and many other places. The display of meteors was not a very abundant one, but what the event lacked in numbers was amply compensated for by the brilliancy of the objects observed.

"Not only were the meteors generally very conspicuous, but they traversed long tracks of the heavens, and their flights were readily traced back to the visual radiant. This year I made the centre at $227^\circ + 54^\circ$ from about eight paths, and there seemed another well-defined shower of similar meteors from $250^\circ + 47^\circ$ in Draco.

"The meteors were of moderate speed and accompanied by trains. They were also well observed by Miss Helen M. Metcalfe, of Kildare, Mr. W. H. Steavenson, of Cheltenham, and others. No doubt some of the larger members of the shower were recorded at several stations, and it is hoped that observers will send in their notes so that the heights and velocities may be computed. January is a good month for large meteoric fireballs, and it remains to be seen whether the last half of the present month will provide the usual number seen in preceding years."

NOVA LACERTÆ.—The weather conditions, in London at any rate, have not been favourable for observations of the new star discovered by the Rev. T. E. Espin on December 30, 1910.

According to observations recorded in the *Times*, Mr. Hinks examined the nova on January 1 and 2, and found it fainter on the second night; a bright line in the red, the C line of hydrogen, was apparently the strongest in the spectrum, and three other bright lines were observed.

Mr. Espin, writing to the *Observatory* (January, No. 431), states that a further examination, on January 1, confirmed his previous observation of the spectrum; it is neither type iii. nor iv. Two bright lines are conspicuous, the stronger one probably F, and a yellow line, which he suggests is D_3. Three bands appear between F and D, and on the more refrangible side of F there is a band so strong as to make the spectrum appear discontinuous; beyond that there is a bright band. The spectrum reminds Mr. Espin of that of R Cygni, with the details more pronounced. He suggests that the star may turn out to be a variable, although, if so, it is curious that it has not been discovered, as have several others in the neighbourhood, at the Harvard Observatory.

A *Daily Mail* report states that no spectrum observations have been possible at Greenwich, owing to the bad weather, but photographs, which show the nova to be decreasing in brightness, have been secured. The Astronomer Royal expresses the opinion that the object is really a nova, not merely a previously undiscovered variable star.

The nova is conspicuous among the stars near by by reason of its distinctly red colour. We append a chart showing its position relative to the bright stars of Cassiopeia, Cepheus, and Lacerta.

Chart showing position of Nova Lacertæ.

COMETS DUE TO RETURN IN 1911.—Mr. Lynn's annual note of the periodical comets due to return this year appears in No. 431 of the *Observatory*. He includes Brooks's 1889 comet, as it was due at perihelion on January 8, but suggests that no further observations of it at this return are likely; it was nearest the earth on August 9, 1910.

Faye's comet, in accordance with Prof. Stromgren's conclusion as to the acceleration of its perihelion passage, returned in 1910, and observations have been recorded in these columns.

Encke's comet is due in the coming summer, but Mr. Lynn, considering its faintness in 1908, fears that we are losing this well-known object, first observed in 1786.

Wolf's comet, of 1884, is not due until early in 1912, but observations may be secured about the end of the present year.

PRELIMINARY RESULTS DERIVED FROM RADIAL-VELOCITY DETERMINATIONS.—At the Boston meeting of the Astronomical and Astrophysical Society of America Prof. Campbell read a paper in which he gave the preliminary results derived from the study of 1073 radial-velocity values.

The position of the solar apex comes out as $A = 272{\cdot}0^\circ \pm 2{\cdot}5^\circ$, $D = +27{\cdot}5^\circ \pm 3{\cdot}0^\circ$, and the corresponding velocity of the solar motion was found to be 17·8 km. This latter value is lower than those previously found, but the available data will yield no higher value. Apparently there is a difference depending upon the spectral type of the stars considered, for, taking 330 stars of types O–F_4, V was found to be 17·7 km., whilst 704 stars of types F_5–G, K and M yielded 18·0 km.

Further, the radial velocities of stars freed from the solar motion component do not appear to be a function of the visual magnitudes. Stars of the later spectral types—as divided above—appear to have radial velocities nearly 50 per cent. greater than those of the earlier types; the increase is progressive. The mean velocity for thirteen nebulæ considered is 23·4 km. The results also confirm Kapteyn's theory of a systematic drift.

In making the observed radial velocities and the proper motions to correspond, it was indicated (1) that the stars of different magnitudes are less differentiated in distance than has hitherto been supposed; (2) all the brighter stars down to the fifth magnitude are further away than indicated by the formulæ for mean parallaxes; (3) the parallax stars which have been used as sample stars are not representative of the stars in general. Some of these results may be modified by the proposed solution, using Boss's proper motions now available.

Other results accruing from the systematic study of radial velocities indicate that, in general, the periods of revolution are shorter for the early than for the later types; the orbits also show less eccentricity. Seventy orbits, now known with reasonable certainty, are in accord with the theoretical conclusions of Darwin, Poincaré, and See regarding the origin and development of binary stellar systems (Journal R.A.S. Canada, vol. iv., No. 5).

STELLAR MAGNITUDES.—A popular and very interesting paper on stellar magnitudes is published by Mr. J. E. Maybee in No. 5, vol. iv., of the Journal of the Royal Astronomical Society (Canada). Mr. Maybee explains the system of magnitudes, tells how they are determined, and discusses some of the interesting facts which have accrued from photometrical studies of the stars.

Astronomical students and amateurs will probably find a great deal of useful information in the paper.

PRIZE SUBJECTS PROPOSED BY THE PARIS ACADEMY OF SCIENCES FOR 1912.

GEOMETRY.—Grand prize of the mathematical sciences (3000 francs). The subject proposed for 1912 is the improvement of the theory of algebraic differential equations of the second or third order the general integral of which is uniform. No memoirs having been received on the question proposed for 1910, this will also be awarded in 1912. Francœur prize (1000 francs), for work useful to the progress of pure or applied mathematics; Poncelet prize (2000 francs), for a work on pure mathematics.

Mechanics.—Montyon prize (700 francs), for inventions or improvement of instruments useful to the progress of agriculture, or the mechanical arts or sciences; Fourneyron prize (1000 francs), for a memoir on the theory and experiment of air resistance, applicable to aviation. The question set for 1910 is also postponed to 1912. Boileau prize (1300 francs), for researches on the motion of fluids contributing to the progress of hydraulics. As an alternative, the funds may be applied to the assistance of a scientific man without means.

Navigation.—The extraordinary prize of 6000 francs, for work tending to increase the efficiency of the French naval forces; Plumey prize (4000 francs), for an improvement in steam engines or any other invention contributing to the progress of steam navigation.

Astronomy.—Lalande prize (540 francs), for a memoir or work useful to the progress of astronomy; Valz prize (460 francs), for the author of the most interesting observation made during the current year; Janssen prize, a gold medal awarded for a discovery or work representing an important progress in physical astronomy.

Geography.—Tchihatchef prize (3000 francs), for the encouragement of exploration in the lesser known portions of Asia; Binoux prize (2000 francs), for original geographical work; Delalande-Guérineau prize (1000 francs); Gay prize (1500 francs). The question proposed for 1912 is the study of the tides of the earth's crust.

Physics.—Hébert prize (1000 francs), for a treatise or discovery concerning the practical employment of electricity; Hughes prize, for a discovery or work contributing to the progress of physics; L. La Caze prize (10,000 francs), for works or memoirs contributing to the progress of physics.

Chemistry.—Jecker prize (10,000 francs), for works contributing to the progress of organic chemistry; Cahours prize (3000 francs), for the encouragement of young chemists; Montyon prize (unhealthy trades) (prize of 2500 francs and a mention of 1500 francs), for a means of rendering a trade or calling less unhealthy; L. La Caze prize (10,000 francs), for the best work on chemistry.

Mineralogy and Geology.—Victor Raulin prize (1500 francs), for facilitating the publication of works relating to mineralogy and petrography.

Botany.—Desmazières prize (1600 francs), for the best work published during the year on cryptogams; Montagne prize (1500 francs), for memoirs on the anatomy, physiology, development, or description of the lower cryptogams; de Coincy prize (900 francs), for a work on phanerogams.

Anatomy and Zoology.—Savigny prize (1500 francs), for the assistance of young travelling zoologists, not receiving Government support, concerning themselves specially with the invertebrates of Egypt and Syria; Da Gama Machado prize (1200 francs), for memoirs on the coloured parts of the tegumentary system of animals; Thore prize (200 francs), for the best work on the habits and anatomy of one species of European insects.

Medicine and Surgery.—Montyon prize (2500 francs, and mentions of 1500 francs), for works or discoveries useful in the art of healing; Barbier prize (2000 francs), for a discovery useful in surgical, medical, or pharmaceutical science, or in botany in relation to medicine; Breant prize (100,000 francs), for the discovery of a specific cure for cholera, or, as an alternative, for the discovery of the causes of this disease, leading to its eradication; Godard prize (1000 francs), for the best memoir on the anatomy, physiology, and pathology of the genito-urinary organs; Baron Larrey prize (750 francs), for a work dealing with the subject of military medicine, surgery, or hygiene; Bellion prize (1400 francs), for works or discoveries useful in medicine; Mège prize (10,000 francs); Argut prize (1200 francs), for the discovery of a remedy for a disease at present incurable.

Physiology.—Montyon prize (750 francs), for experimental physiology; Philipeaux prize (900 francs), for experimental physiology; Lallemand prize (1800 francs), for researches relating to the nervous system; L. La Caze prize (10,000 francs), for the best work on physiology; Martin-Damourette prize (1400 francs), for a work on therapeutical physiology; Pourat prize (1000 francs), for new data on the utilisation and assimilation of albumenoids in food.

Statistics.—Montyon prize (1000 francs, and two mentions of 500 francs), for the best memoir on questions relating to statistics.

History of Sciences.—Binoux prize (2000 francs).

General Prizes.—Arago medal, Lavoisier medal, Berthelot medal, Henri Becquerel prize (3000 francs), Gegner prize (3800 francs), Lannelongue prize (2000 francs), Tremont prize (1100 francs), Wilde prize (one of 4000 francs and two of 2000 francs), for work in the fields of astronomy, physics, chemistry, mineralogy, geology, or experimental mechanics; Longchampt prize (4000 francs); Saintour prize (3000 francs), for work in the physical sciences; Victor Raulin prize (1500 francs), for work in mineralogy and petrography; Bordin prize (3000 francs), for researches on determining sex in living beings; Houllevigue prize (5000 francs); Caméré prize (4000 francs); Jérome Ponti prize (3500 francs); prize founded by Mme. la Marquise de Laplace; Felix Rivot prize (2500 francs).

HALLEY'S COMET.

ALTHOUGH our British skies were so unfavourable for observations of Halley's comet, the almost constant flow of published results shows that those astronomers more fortunately situated in clearer atmospheres and lower latitudes reaped a rich harvest; some of the most striking results are briefly referred to below.

Among the favourably situated observatories, that at Johannesburg, the Transvaal Government Observatory, was one of the most favoured, and appears to have used its opportunities to the fullest possible extent. Brief notes have appeared in NATURE from time to time, but in Circular No. 4 the results to the end of June are described in full, and illustrated by some forty reproductions of photographs and numerous drawings of the nucleus and head on various dates.

The photographs are described by Mr. H. E. Wood, who, at the request of Mr. Innes, the director, employed the 10-inch Cooke lens, of 44·6 inches focal length, to photograph the comet on every possible occasion. This instrument is the one presented to the observatory by Mr. Franklin-Adams, and has two finders, one of which is mounted on swivels, allowing it to be moved in two directions; this device proved exceedingly useful for getting the whole of the comet on the plate when the length of the tail exceeded 8°.

On the original photographs the scale is 1°=20 mm., but in reproducing them this has been slightly reduced, and varies, on the nine plates, between 19·2 and 14·2 mm. per degree.

Between April 11 and June 3 the weather conditions were very favourable, except for the occasional intrusion of the moon, and photographs were secured on forty-four dates. Their general excellence is emphasised by two unmounted, direct prints which accompany the circular, thus affording a comparison between original and reproduction. Seven of the photographs were taken by Mr. Mitchell, the others by Mr. and Mrs. Wood, and Mr. Wood describes each in detail.

The maximum lengths of the tail shown on the photographs are 17° on May 6 (60 minutes' exposure), 17° 15′ on May 14 (38 minutes), and 18° on May 30 (120 minutes), but in each case the image of the tail evidently extended beyond the edge of the plate. On June 3, however, 120 minutes' exposure failed to record more than 4° 30′ of tail.

The majority of the photographs show a composite tail

in which a number of rays appear to emanate from a point immediately behind the nucleus, while the envelopes around the nucleus appear to form a cap over the tail. Extraordinary irregularities and contortions are shown on the photograph of May 21, which is an exceptional one. The first photograph of the series, taken on April 11, showed a fan-shaped tail 9′ long after 4 minutes' exposure. This gradually increased, and on April 19 (37 minutes) a tail of 7° 45′ long was depicted, which was straight for 4° and then appeared to be blown to the south quite suddenly, the remaining part being very faint. A very confused, intricate, and contorted tail was photographed on April 21, one bright streamer, forming the northern boundary, bending twice at right angles at about 45′ from the head.

On May 4 the photograph which we here reproduce, from one of the direct prints, was taken with 30 minutes' exposure, and shows a tail 15° long to the edge of the plate. At 5° from the head the breadth was 1°, and the tail appears to be composed of a large number of overlying shafts with a central bright streak. The southern edge is slightly convex, and shows a number of delicate branches emerging from it with striking regularity; the northern edge is quite simple.

FIG. 1.—Halley's Comet, May 4, 1910. Photographed at the Transvaal Observatory. Exposure 30 minutes.

Later photographs show a great number of streamers, ten rays being visible near the head on May 8; but the tail was straight, no branching of the streamers being shown. Three days later the tail was bifurcated by a dark central space, along the north edge of which there was a bright ray; this division was accentuated on a later photograph taken on May 11. An elongation of the head appeared on May 12, when the envelopes about the nucleus extended to a distance of 1° behind it. The last photograph before transit was taken on May 16 with 12 minutes' exposure, and shows 9° of tail, which was 2° 5′ wide at a distance of 5° from the nucleus. The greater brightness of the envelopes on the southern edge is noticeable to a distance of 1° from the nucleus, and the tail appears quite simple, without rifts or rays.

After the transit, on May 21, a condensed stellar nucleus was shown on the photographs, and the envelopes on the northern edge were stronger than those on the southern. But on May 25 the envelopes were apparently symmetrical, and two days later the nucleus was very bright, and there was no visible condensation. On June 25 the head was much broader than the tail, and appeared to be granular, suggesting a very close cluster of small stars; this, Mr. Wood suggests, may be a photographic effect. Although on several photographs taken in June the head is described as being large, no mention is made here of the division of the nucleus as recorded by other observers.

The circular also contains a most interesting *résumé* of the measured lengths of the tail recorded visually by Messrs. Innes and Worssell. The greatest apparent length was on May 19, when the tail extended 150° from the assumed position of the head; the greatest length actually seen and measured, with the whole comet visible, was 107°, on May 17. As mentioned in an earlier circular, the eastern, or morning, tails were seen at Johannesburg three days after the transit of the comet, but Mr. Innes believes that a rupture took place before May 18, and that the eastern tails seen on May 21 were not then connected with the main body of the comet. Mr. Innes's testimony as to the magnificence of the comet is worth quoting here. He says:—"It may be said that it would require much imagination to desire a more impressive and brilliant spectacle than that presented by Halley's comet on the mornings of May 15, 16, and 17. It was indeed a 'Great Comet,' such as the writer had never seen before and can hardly expect to see again."

No less interesting are the notes regarding the general visual appearances between January 25 and July 6, but space will not permit mention of more than a few of them. A secondary nucleus was measured on April 16, and was then 12″, in position angle 48·3°, from the primary; this appearance of a second nucleus was not persistent, but was recorded, on and off, many times. The drawings from the visual observations are reproduced on Plates x. and xi., and form a valuable record of the innumerable changes in the various phenomena attending the comet during the apparition. On May 6 the head was decidedly yellowish, an appearance not noted before, and the tail apparently intercepted about half the light of the star B.D. +8·5°, reducing its relative magnitude by 0·8. The nucleus and bright coma were also recorded as decidedly yellow on May 12, when the jets from the nucleus had a most extraordinarily complicated appearance, which was accentuated on the succeeding day (see Nos. 31–34, Fig. 2).

After the transit the visual observations showed a stellar nucleus without jets or rays, which, however, developed later. The nucleus, too, changed and became multiple, and three nuclei were recorded on June 2. Later, the separate nuclei appear to have become diffuse, and on June 4 had the appearance of a large, out-of-focus double star, distance about 4″, almost resolved; the colour was still yellow. By July 6 the head, although much brighter in the centre, showed no stellar nucleus.

Father Goetz, of the Buluwayo Observatory, also contributes some notes of visual observations, and gives a sketch of the comet's head as seen on May 13; a peculiar feature is a much brighter segment of the inner envelopes immediately in front of the nucleus. Two faint stars were seen through the coma on May 21, and were not appreciably dimmed.

A number of meteorological phenomena were recorded by the observatory staff and by numerous correspondents. Especially interesting are the lunar-halo phenomena depicted on Plate xii., and the note that unusually high temperatures were recorded at the observatory during the time of the comet's passage.

Mr. Innes offers to lend, under suitable conditions, the original drawings reproduced on Plates x. and xi. to any recognised investigator who may require them.

The Utrecht observations of the comet are recorded by Profs. Nijland and van der Bilt in No. 4453 of the *Astronomische Nachrichten*. They give positions from December 3, 1909, to May 27, and a number of notes describing the various peculiar phenomena observed. They also record the yellow and orange-yellow colour observed early in May, and direct attention to the various shapes and position angles assumed by the head. The sketches made between April 29 and May 6 so nearly resemble, in their peculiar forms, those made by Bessell and others in 1835, that the present observers suggest that the great periodic comet has its own special physiognomy.

The same journal contains a record of the observations

made by M. F. Sy at the Algiers Observatory. Positions are given for the period April 10 to July 10, and the various phenomena of the head and the tail are briefly described. Observations of Venus and the comet, as suggested by Prof. Birkeland, were made, under adverse conditions, on May 2, but no special phenomena were remarked. Similar duplications of the nucleus to those recorded at Johannesburg were observed on May 3, 8, and later dates, but only a single nucleus was seen on May 5. A notable recrudescence of brightness apparently took place on July 9, as compared with July 5 when a nebulosity, 1′ in diameter, and no nucleus were seen. References to these alternating duplications of the nucleus are made in the December (1910) number of the *Bulletin de la Société astronomique de France*, where MM. Millochau, Borrelly and others describe their observations. M. Jamain finds that the successive appearances are best explained by the supposition that the nucleus of the comet had a rotatory motion, with a period of about 21·5 hours.

In No. 4461 of the *Astronomische Nachrichten* Dr. J. Mascart reproduces three excellent photographs, and three drawings of the head, taken at his special observing station at Teneriffe during May and April respectively; the complicated structure of the head on April 16 and 18 is especially remarkable. But Dr. Mascart deals chiefly with the conditions of observation on a mountain site, and strongly emphasises the advantages which accrue from the establishment of an astronomical observatory in a clear atmosphere and at a high altitude, yet more or less readily accessible. Finally, he suggests the necessity for establishing an important and permanent international observatory on Mount Guajara, where he was stationed. Dr. Mascart gives more details, and discusses such matters as the zodiacal light, &c., in an article which appears in the December (1910) issue of the *Rivista di Astronomia*, Turin (vol. iv., No. 12, p. 585).

A note in the December (1910) number of the *Observatory* (No. 429) suggests that, as the comet has now sufficiently emerged from the sun's rays, a few more observations may be secured, even in European latitudes, before it finally disappears until August, 1985. An ephemeris for Greenwich midnight, and extending to the end of March, is given; as the declination is about 18° south, those observatories situated in the southern hemisphere will enjoy better conditions. At present the comet is apparently situated in the constellation Corvus, and is travelling slowly in a south-westerly direction; its position for December 31, 1910, is R.A. = 11h. 53·4m., dec. = 18° 12·7′ south, but after January 11 it will again commence to travel northwards.

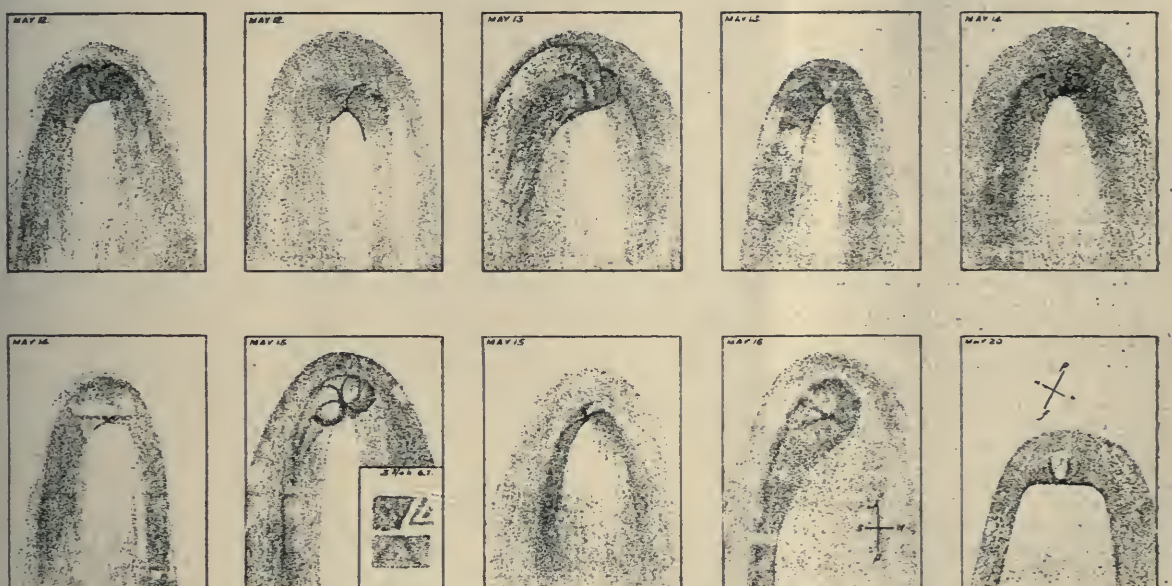


Fig. 2.—Changes in the Head of Halley's Comet, as observed at the Transvaal Observatory.

ON THE ORIGIN OF SLAVERY AND PARASITISM IN ANTS.

Two interesting papers on the origin of slavery and parasitism in ants, by Henri Piéron, Maître de Conférences à l'Ecole pratique des Hautes-Etudes, have appeared recently in the *Revue générale des Sciences* (September 15 and 30, 1910), and the main points are summarised below. The papers are conveniently divided into sections, and are rendered more valuable by full references being given for all the statements referred to.

I. Females: Foundation of Colonies.

(1) *Foundation of a New Nest by a Fertilised Female.*—After the marriage-flight of ants, the males and females fall to the ground, when the males die, and those of the females which escape the numerous dangers to which they are exposed taken refuge in crevices in the ground, where they lay their eggs. For a month or more the female appears to subsist largely by the absorption of the alary muscles, now no longer required; but in some cases, as in *Atta sexdens*, the female carries with her a supply of the mycelium of an edible fungus, on which she and her progeny afterwards subsist. The earliest hatched workers in nests founded by a single female share her privations, being much smaller than those hatched later. In some cases a portion of the eggs are sacrificed for the nourishment of the female and the newly-hatched larvæ, and are also used by *A. sexdens* as a hot-bed for the fungus. Some of the species of ants in which nests are founded by a single female are among the oldest in existence, going back, almost unchanged, to Tertiary times.

(2) *Foundation of a New Colony in a Pre-existent Nest.*—Female ants will sometimes take up their abode, and rear a fresh colony in the deserted nests of other species, or even, on more or less friendly terms, establish a colony of their own in inhabited nests of other species. On the other hand, ants of the genus Solenopsis, &c., usually form nests in small galleries round and communicating with the nests of larger species, which they plunder at will, without the larger ants being able to pursue them into their narrow fastnesses.

(3) *Foundation of a New Nest with the Aid of Workers of the same Species.*—The females of some ants are unable to form a new colony without the aid of workers, and if they fall to the ground near their own nest, or one of the same species, they may return to the nest, or may be joined by a colony of workers, and thus assisted to establish a new one.

(4) *Foundation of a New Colony with the Aid of Workers of another Species.*—Although ants usually

destroy those of other species which enter their nests, they will sometimes receive females, especially if fertilised, into their communities, whether females of their own species are living in the nest or not, and hence mixed nests of two or more species may originate. Many instances are quoted, both among European and American ants, and the author sums up the various alternatives as follows:—(i) isolated workers may dig a nest for the queen and make their dwelling with her; (ii) she may be received into a nest which has lost its own queen; (iii) she may be received into a nest possessing a queen, whom she kills and supersedes; (iv) she may be received into a nest where a queen lives, whom she does not injure, but who disappears, either making her escape or being killed by the workers; (v) she may be received into a nest where the former queen remains, and continues to perpetuate her brood.

Illustrations of these alternatives are then given, with comments, and the author concludes that the formation of new colonies depends rather on the behaviour of the workers than on that of the queen.

(5) *Foundation of a New Colony by Conquests of Nymphs.*—This section relates to cases in which a warlike queen enters the nest of another species and drives away the adult ants, establishing herself as the queen of their undeveloped progeny. These cases form transitions to those in which a queen is received into the nest of another species where the former queen still lives, and both species subsequently live together in harmony and perpetuate a mixed nest.

II. WORKERS: PERPETUATION OF COLONIES.

(1) *Perpetuation by Workers without Allies.*—In cases where the queen founds a nest, and is afterwards supported only by her own progeny, the duties of the workers are generally less defined than in bees. These duties fall under four categories:—nutrition, rearing, construction and protection, and warfare.

(2) *Perpetuation of a Nest with the Temporary Aid of Auxiliaries.*—In cases where a female has fallen among a nest of a different species, or a band of workers which have adopted her, and a mixed nest is the result, a tendency seems to persist to carry off nymphs of other species, which is one cause of ant-slavery.

(3) *Perpetuation by Nutrition (Myrmecophily).*—This relates to the actual parasitism of various species of ants which inhabit the nests of others either as guests or (as in Solenopsis, to which we have already alluded) as parasites.

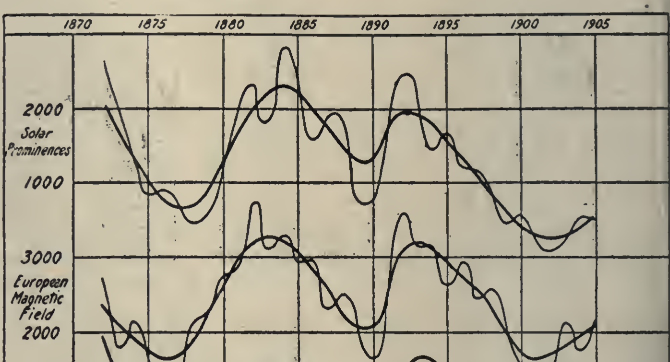
(4) *Perpetuation by the Permanent Aid of Auxiliaries.*—This relates to ant-slavery proper, where the mistresses are more or less completely dependent on their slaves for their very existence.

(5) *Perpetuation in the Complete Absence of the Workers of a Species.*—The strangest cases of all are perhaps those of certain species of ants which are only male and female, and which live parasitically in the nests of others. Sometimes when such a workerless queen introduces herself into a strange nest the workers kill their own queen instead of the intruder, in which case the colony is inevitably devoted to destruction by the impossibility of any further production of workers.

In his second paper M. Piéron reviews and comments on the views of Darwin, Wasmann, Wheeler, Emery, and Santschi on the various problems connected with ant-life. He regards *Formica fusca* as an ancestral form of the genus Formica, it being undistinguishable from *F. flori* found in Baltic amber, and having thrown off a series of closely related forms in most parts of the world. This ant shows the primitive stage in which the new nest is formed by the female only. Thence we pass on to *F. rufa*, of which the female can only found her nest with the aid of workers of her own or another species, and from thence to the stages of slavery and parasitism. Then M. Piéron discusses the general problem of the origin of slavery and parasitism among ants, the theory of progressive stages leading to these curious habits, the explanation of the different conduct of the females, the problem of the rise of slavery and parasitism among neuters, and the origin of aid and tolerance towards intruders of other species. His final conclusion seems to be that in proportion as evolution leads further and further from a primitive state, insects, like men, become more and more dependent on each other. Among ants, those with the simplest and most primitive habits are the most abundant, while as they become slave-holders, and later on parasites, their colonies and individuals become rarer and rarer. It is evident that when ultra-civilisation degenerates into slavery and parasitism it is neither good for man nor ant.

TEMPERATURE CHANGES AND SOLAR ACTIVITY.

PROF. F. H. BIGELOW (*American Journal of Science*, vol. xxx., August, 1910, p. 115) has been discussing the variations of the mean annual temperature of the United States of America and their relation to the changes of solar activity as shown by the frequency of sun-spots and prominences.



Prominences, magnetic field, sun-spots and the temperature amplitudes and excesses of the United States.

To arrive at a correct estimate of the mean temperature of the States and the departure from the mean for thirty-three years, monthly maps showing the departures of about 100 stations were prepared, and lines of equal departures drawn. The product of the area under one sign and the departure gives a "temperature volume." The difference between the negative and positive "temperature

volumes" gives the measure of the departure of the whole area from the thirty-three-year mean. The sum of the two volumes (regardless of sign) is given as the amplitude of the departures during the month. Annual mean departure numbers and annual mean amplitude numbers were obtained and plotted as curves, and compared with curves of solar prominences and sun-spots and the mean horizontal magnetic force (see figure). (The two temperature curves are inverted.)

Prof. Bigelow says:—"The synchronism in the long period between the two solar curves and the three terrestrial curves cannot be questioned, that for the magnetic field being direct and those for the temperature system of the United States being inverse." . . . "The synchronism between the curves of short period is not so well pronounced as for the long period . . . ;" and Prof. Bigelow points out that this may well be due to inherent imperfections in the solar and magnetic observations.

Arguing that an increase of solar action produces an increase of temperature in the tropics but a relative decrease in the temperate zones because of the increased flow of cold air from the poles to the equatorial regions, Prof. Bigelow produces this set of curves as evidence, and points out that the succession of minor crests is about three years, this being the three-year period which he first described in 1894.

It is unfortunate that this investigation has been kept to the limits of the United States. It does not absolutely follow that the case is proved for the whole temperate zone. Prof. Bigelow remarks that "there is a tendency for temperature to oscillate about a sort of nodal line on the Eastern Edge of the Rocky Mountain Plateau," and one wonders what would have been the effect on the curves had the plateau occupied the greater instead of the less part of the States.

M.

LONDON COUNTY COUNCIL CONFERENCE OF TEACHERS.

THE meetings held at Birkbeck College on January 5, 6, and 7, were no less important than those of the twelve preceding years. Indeed, the general standard of papers read was higher. The audiences ranged from 500 to 800, and they showed a better appreciation of improved principles and methods than was evident, say, seven years ago. In the case of the earlier conferences there was undoubtedly a tendency for the listeners to say, "This method of teaching is all very well—ideal perhaps—but impossible under the conditions in *my* school." By his organisation of these conferences, Dr. Kimmins has brought home to those who have attended them the fact that work of the finest quality is actually done under conditions which appear, or even are, the most adverse. Not once, but fifty times, have these meetings demonstrated that the possibility of working on improved lines depends on the inspiration of the teacher.

Recognition of the dominant influence of the teacher in the practice, as distinct from the administration, of education, was made by the chairman of the London County Council Education Committee, Mr. E. A. H. Jay, who presided at the opening session, and Mrs. Bryant's plea for specialisation derives much of its weight from this recognition.

The most largely attended meeting was that opened by Mr. George Alexander, who urged the value of dramatisation and of good elocution by the children. It was clear that he was preaching to the converted. The discussion on "Memory" was of interest, as it brought out in a remarkable way the utility to the teacher of recent work in experimental psychology, notwithstanding the fact that the professional psychologists regard such application of their work as premature. The application of scientific method to education means that teaching will be brought more and more into harmony with an increasingly trustworthy psychology. Further, it means that the teaching of history will be more scientific (as exemplified in the masterly paper read by Mr. B. Lewis) and the teaching of science more historical and humanistic. It will mean a new educational era.

Specialisation in Teaching.

Mrs. Bryant, headmistress of the North London Collegiate School, opened the discussion on this subject with a paper advocating a certain degree of specialisation on the part of every teacher of a staff. She assumed that it was more normal for teachers to specialise than not, and that there was something artificial in a school where every teacher taught everything. In a condition of free growth, schools developed from a minimum of specialisation in the subjects taken by each teacher towards a state in which nearly all progressive teachers specialised more or less. Specialisation did not mean limitation entirely to one subject; still less did it mean one teacher, one subject, all the teacher's life. There were persons who taught mathematics only, or classics only, or science only, for all their life's career. These were specialists in a special sense; but these subjects were not only large in extent, but multiple in the nature of the subject-matter they comprised. There was, however, a specialisation open to the humblest holder of a pass degree or a teacher's certificate. For all sorts of reasons, teachers have the ability and an impulse to specialise—and to vary their speciality. To learn a new thing and then have an audience to talk to and make talk about it—this is the joy of the teacher who *is* (not merely *was*) a student also. Moreover, the learners share the joy, and are stimulated thereby. Again, the move may come from a sense that there is a need for a certain kind of knowledge in the school curriculum. We see this just now in the case of teachers who believe that Scripture should be taught with more intelligence and scholarship. The practical motive sets going the movement towards patient study, and presently we have enthusiastic learners who are also effective teachers. The modern head of a school could organise the work so that each teacher took a larger share in the work she was best fitted to teach, so that without one dismissal or resignation the advantages of limited specialisation could be secured. These advantages were great:—(1) the scholarship of the teaching staff was raised, and therewith that of the learners, ideas were more accurate, inquiry more thorough, interest more real, curiosity more lively and fresh; (2) the teacher became a student, and to little children the reality of this made all the difference. The good teacher is always finding some new problem and solving it, just as the bad administrator is always trying beforehand to settle how everything is to be done. It was well that variety of personal influence should be brought to bear upon the child; moreover, the sense of belonging, not to the class merely, but to the larger whole of the school, is quickened when the child has real acquaintance with many members of the staff.

Mr. Frank Bulley gave a clear account of the simple arrangements made in the John Ruskin School, whereby the main advantages of specialisation are being secured in an elementary school. Dr. Borland urged that assistant teachers should be encouraged to specialise in music, and that one or more of such "specialists" should be included in every staff.

Memory.

Prof. J. Adams presided over the second session, which was devoted to the psychology of memory and the influence which our knowledge of this subject should have upon teaching. The chairman introduced the subject with an indication of its difficulty and importance. Dr. C. Spearman spoke on "The Relation of the Memory to the Will." The paper pointed out the remarkable contrast between the present cultivation of the study of memory by psychology and its neglect by education. This was attributed to an unfortunate want of touch between education and psychology, arising largely from the defective character of most psychological text-books. As a result, educationists have generally failed to recognise that memory, taken in its largest significance, embraces more or less exhaustively all the mental processes whatever, of intellect, and even of will. There are, indeed, most important differences between its higher and its lower manifestations, seeing that some persons excelled in the one and some in the latter. Our present exaggerated examination system is, in fact, chiefly disastrous owing

to its predominant cultivation of the lower kinds and to its showering its rewards and honours upon the pupils endowed with these. But, on the other hand, there are also most important resemblances between the two kinds; the fundamental laws of mind have the same form in both cases, and the study of the simpler and more accessible kind seems an indispensable preliminary to obtaining any really scientific and effective grasp of the higher ones. Various instances were given to illustrate the light shed in this manner on many of the most difficult problems in the education of the will, such as the encouragement of good impulses and the repression of bad ones; the fallacies were exposed which underlie the present harmful emphasis laid on game contests between schools, and the pernicious exaggeration of examinations.

The Teaching of Geography.

Mr. B. C. Wallis gave an account of the five years' course adopted in the County Secondary School, Holloway. The first stage dealt with the globe as a model of the earth, and was mainly observational and descriptive. The second stage occupied three years, and was largely heuristic in character, involving quantitative work relating to the world, the North Atlantic shore lands, and the British Isles. In the third stage an attempt was made to apply methods of investigation used in the previous stage to the original authorities, chiefly Government publications.

Mr. C. J. Rose dealt with "Open-air Teaching of Geography," and the financial difficulties in the poorer districts received attention. Mr. C. J. Fairgrieve discussed the problem of the ideal room for indoor teaching of the subject, a problem which certainly needs more attention than it has received hitherto. Mr. Alford Smith opened a useful discussion, and it appears that the revolution in the treatment of geography which has already been accomplished in most secondary schools is making headway in elementary schools, in spite of defective maps and atlases. A great amount of energy, ingenuity, and knowledge is being shown by the most progressive teachers of all classes of schools in the construction of home-made apparatus of a teaching power far surpassing the products of the trade.

Educational Experiments in Schools.

Mr. B. Lewis described the combined scheme of history and geography adopted at the Old Castle Street School. Compared with the sciences, history was apparently amorphous, and clear ideas were best obtained by focussing many converging lines of association on events of world-wide import. He adopted the chronological method; the concentric method failed to emphasise growth and development. He contrasted present with past, and thus tried to cultivate historical feeling. The physical geography of Britain was studied with special reference to the Saxon invasion, that of each European country was associated with that period of its history when it most closely influenced England. For similar reasons the geography of America and India was treated in connection with the events of the eighteenth century, that of the China Seas studied when the Russo-Japanese war was the historical topic, viz. at the end of the course. At the same time the geography of Britain and Europe was distributed over all the standards, as appeared from the details given of one section of the course. The manner in which the scheme was worked out led the chairman, Sir Alfred Keogh, to declare that it was the finest piece of short historical description ever delivered. The Rector of the Imperial College also warmly endorsed the plea, put forward in a paper by Mr. A. G. Gawler, for individual work even in large classes. Mr. Gawler's opinion is that in teaching the path of individuality is the path of least resistance, and the boy who journeyed along it lifted himself to a higher plane. In the concluding meeting papers were read on "Number Teaching," "Stencilling," and "Animals in Infant Schools." Prof. M. J. M. Hill presided, and dwelt upon the association of the University of London with the County Council in promoting educational efficiency.

G. F. D.

THE MAKING OF A DARWIN.[1]

I MAY take my text from a recent remark of Henry Fairfield Osborn, to the effect that a Darwin could not be produced in the American university of to-day. This raises a number of questions, some of them unanswerable, but all of them worthy of the attention of scientific men interested in the continuance of a race of investigators.

As a starting point we may quote Prof. Osborn's words in full:—

"If 'the poet is born, not made,' the man of science is surely both born and made. Rare as was Darwin's genius, it was not more rare than the wonderful succession of outward events which shaped his life. It was true in 1817, as to-day, that few teachers teach and few educators educate. It is true that those were the dull days of classical and mathematical drill. Yet look at the roster of Cambridge and see the men it produced. From Darwin's regular college work he may have gained but little, yet he was all the while enjoying an exceptional training. Step by step he was made a strong man by a mental guidance which is without parallel, by the precepts and example of his father, for whom he held the greatest reverence, by his reading the poetry of Shakspere, Wordsworth, Coleridge and Milton, and the scientific prose of Paley, Herschel and Humboldt, by the subtle scholarly influences of old Cambridge, by the scientific inspirations and advice of Henslow, by the masterful inductive influence of the geologist Lyell, and by the great nature panorama of the voyage of the *Beagle*.

"The college mates of Darwin saw more truly than he himself what the old University was doing for him. Prof. Poulton, of Oxford, believes that the kind of life which so favoured Darwin's mind has largely disappeared in English universities, especially under the sharp system of competitive examinations. Yet this is still more truly the atmosphere of old Cambridge to-day than of any of our American institutions. It would be an interesting subject to debate whether we could nurture such a man; whether Darwin, were he entered at a Columbia, a Harvard, or a Princeton, could develop mentally, as Charles Darwin did at Cambridge in 1817. I believe that conditions for the favourable nurture of such a mind are not with us. They are repose, time for continuous thought, respect for the man of brains and of individuality, and of such peculiar tastes as Darwin displayed in his avidity for collecting beetles, freedom from mental convention, general sympathy for nature, and, above all, order in the world of ideas. If the genial mind cannot find the kindred mind, it cannot develop. Many American school and college men are laughed out of the finest promptings of their natures. In short, I believe our intellectual environment would be distinctly against a young Darwin of to-day."

These words of Osborn hint at certain weaknesses in our American educational system to which I shall refer later on. Meanwhile, I do not think that it is the whole truth or wholly the truth. If a Darwin were to be "laughed out" of his career, the event would have occurred in the English secondary school, where he was, in fact, nicknamed "Gas" on account of his interest in chemistry; and it is certainly not true that in the old Cambridge or the new Cambridge there is as high a valuation of unexpected originality as the supposititious young Darwin would find to-day in America.

I think that the elements which make up a Darwin can be reduced to three, whereof the first far overtops the others, the heredity of great genius being far more rare than one would infer from Osborn's words, and far more difficult to mar or discourage.

What, then, are the elements that we unite to make a great investigator, not of Darwin's class, let us say, for that comes only with many centuries, but a naturalist not unworthy to come in as a footnote to a page on Darwinism? The fundamental elements, as I take it, are these three: first, the original material, to which we may look to heredity alone; second, meeting nature at first

[1] Presidential address delivered before the American Association for the Advancement of Science, Minneapolis, December 27, 1910, by Dr. David Starr Jordan.

hand, and meeting her early and persistently; third, the personal inspiration and enthusiasm derived from some great teacher. In Darwin's case the raw material was of the highest order, the best which amphimixis ever put together. This material no university could spoil, though Cambridge and Edinburgh confessedly tried their best. Beetles, racehorses, flowers and trees, contact with nature—these kept up an enthusiasm promoted rather than checked by the hopeless dreariness of his university exercises. These gave the second element, and the third came from the privilege of the young Darwin to be "the man who walked with Henslow," and later with Sedgwick also.

In the American universities, heredity plays her part; her limitations, whatever they may be, are racial, and our stock is good. Nature is close at hand, closer than in the Old World, and whosoever is really filled with zeal to know her has not far to go. Agassiz remained in America because in America he was nearer to his studies than he could be in Europe. Here "nature was rich, while tools and workmen were few and traditions none." All this our American universities offer in abundance. The final question is, then, that of personality, and the question I would raise is whether, in accumulating tools and traditions even as in Europe, we are not failing in this regard. Are we not losing sight of the *man*, of the thing, above all others, which goes to the shaping of a great naturalist or a great scholar in any field? We may say that the machinery of our universities is developed, not for the shaping of a Darwin, but for the moulding of very commonplace models. But so it is everywhere. Paulsen could never conceive that any of the great scholars of England should be professors in an English university. The work of the university, with its gowns and hoods, its convocations and degrees, its taking seriously the State-governed Church and the hereditary aristocracy, seem so alien to the life of the great scholar that one cannot conceive his taking part in them. Yet great scholars have done just this. They have developed in just this atmosphere, drinking from the real fountains of learning hidden within the university, and not from the drippings of the gargoyles with which mediævalism has adorned its exterior.

In like fashion we could not conceive of the young Darwin, in a claw-hammer coat, in the afternoon defending his one major and two minors with a thesis which no one will ever read, on a topic leading up a blind alley, as a doctor in any German university. But even this, or much worse or more incongruous, might happen to a Darwin or a Huxley, or a Lyell or a Gray, or a Helmholtz, an Agassiz or a Gegenbaur, were such to grow up into the universities of to-day. Externals count for little, and all these things are external. The man, the teacher, and the contact with nature—these are the only realities. The beginning is in the man, his ability, his "fanaticism for veracity," and his persistence in the work. The university cannot make the man. It cannot wholly shut him away from objective truth, even if it tries desperately to do so, and its principal influence is found in the degree to which its grants the inspiration of personality.

The reading of good books cannot be regarded as an element peculiar to any sort of university training. A good mind seeks good books and finds them. Shakespeare, Coleridge, and Lyell were just as accessible to me or to you as they were to Darwin. They are just as accessible to anybody anywhere. Time to read them is not even essential. One secret of greatness is to find time for everything in proportion to its worth to us. A further advantage is ours in this generation. We have the "Origin of Species" and the whole array of fructifying literature arising from this virile stem.

The only possible element in which the American university could fail is that of the influence of personality. Can it be that this influence is waning? Do our men no longer "walk with Henslow," as once they walked with Gray and Silliman and Agassiz?

Do our men go to the university for the school's sake and not for the men who are in it? Is it true that as our universities grow in numbers and wealth, their force as personal centres or builders of schools of thought are declining? To some extent this is certainly true. Once, when a young naturalist went in search of training and inspiration, he went to Agassiz. He did not go to Harvard. He scarcely thought of Harvard in this connection. Agassiz was the university, not Harvard. The botanist went to Gray. He did not go to Harvard. Later the chemist went to Remsen, the physiologist to Martin, the anatomist to Mall, the morphologist to Brooks. That these four men happened to be together at Johns Hopkins was only an incident. The student went out to find the man, and he would have followed this man around the world if he had changed from one to another institution.

I saw the other day a paper of an irate German morphologist who, in attacking a certain idea as to the origin of fishes' arms and ours, denounced "die ganze Gegenbaurische Schule" who followed Gegenbaur in his interpretation of this problem. Never mind the contention. The point is that there is a Gegenbaur school of morphology. This school was not the university, but Gegenbaur himself. We ought to have more such schools in America, schools of advanced thinkers gathered around a man they love, and from whose methods and enthusiasm the young men go away to be centres of like enthusiasm for others. I believe that our system of university fellowships is a powerful agency in breaking up this condition. If, by chance, it were possible for us to produce a Darwin, the raw material furnished, it would be a difficult task if a fellowship of 500 dollars has drawn him to the laboratory of some lesser plodder, preventing him for ever from being "the man that walked with Henslow."

The fellowship system keeps our graduate courses running regardless of whether these courses have anything to give. So long as our fellows are hired to take degrees, then sent out to starve as instructors, so long shall we find our output unworthy of our apparent advantages; and in our sober moments we shall say with Osborn, we do not see how an American university could produce a Darwin. At the same time, professors in universities in other lands will admit that the machinery for mediocrity offers little promise to the great. Jacques Loeb tells the story of a young man who applied through him for a fellowship in physiology at Chicago. His admiration for Loeb's wonderful genius as an experimenter and as an original worker on the borderland of life and matter led him to wish to work with Loeb above all other things. Loeb wrote back that he had resigned his chair in the University of Chicago to go to the University of California. Then, said the candidate, "will you kindly turn over my application for a fellowship to your successor at the University of Chicago?" This single case is typical of the attitude into which our fellowship system, as it is now administered, throws the young digs who arise in our various colleges. The embryo professor asks for his training, not for the man of genius who will make him over after his kind, but for the university which will pay his expenses while he goes on to qualify for an instructor's position. By this and other means we are filling the ranks of our teaching force, not with enthusiasts either for teaching or for research, but with docile, mechanical men, who do their work fairly, but with few touches of the individuality without which no Darwins nor Darwinoids can ever be produced. It is a proverb at Harvard, I am told, that "the worm will turn, and he turns into a graduate student."

Thirty-seven years ago it was my fortune as a beginner in science to attend the meeting of this association at Dubuque. The very contact with men of science which this meeting gave was a wealth of inspiration. To hear these men speak, to touch their hands, to meet them on the street, to ride with them to the fossil-bearing rocks or the flower-carpeted prairie, for the moment, at least, to be counted of their number, all these meant wonderful things.

Of these men, let me speak primarily of the students of natural history, for then, and even yet, I know little of anything else. They were naturalists "of the Old School," these workers of the early 'seventies. Louis Agassiz, dean of them all, was not at Dubuque, but I came to know him very soon after. There was Asa Gray. I heard at Dubuque some Harvard man say, "There goes Asa Gray. If he should say black was white, I should see it looking whitish." There was Shaler, the many-

sided, every side altogether charming; and Spencer F. Baird, the father of cooperative science, the science at the Capitol at Washington. There was Fred Putnam, the ever-present veteran, a veteran even in his youth. There was Joe Le Conte, ever clear-headed and ever lovable. There was Newberry and Leslie and Gill and Allen and Swallow and Leidy and Calvin and Marsh and Coues, Wilder with his shark brains, and Scudder with his butterflies, and I know not what others, the great names of thirty years ago, names which we honour to-day.

These men of the Old School were lovers of nature. They knew nature as a whole rather than as a fragment or a succession of fragments. They were not made in Germany or anywhere else, and their work was done because they loved it, because the impulse within would not let them do otherwise than work, and their training, partly their own, partly responsible to their source of inspiration, was made to fit their own purposes. If these men went to Germany, as many of them did, it was for inspiration, not for direction; not to sit through lectures, not to dig in some far-off corner of knowledge, not to stand through a doctor's examination in a dress coat with a major and two minors, not to be encouraged *magna cum laude* to undertake a scientific career. The career was fixed by heredity and early environment. Nothing could head them off, and they took orders from no one as to what they should do or what they should reach as conclusions. They did not work for a career—many of them found none—but for the love of work. They were filled with a rampant, exuberant individuality which took them wherever they pleased to go. They followed no set fashions in biology. Such methods as they had were their own, wrought out by their own strength. They were dependent neither on libraries nor equipment, though they struggled for both. Not facilities for work, but endeavour to work, if need be without facilities, gave them strength, and their strength was as the strength of ten.

For this reason each typical man of this sort had Darwin walking with him. He became the centre of a school of natural history, a rallying point for younger men who sought from him, not his methods or his conclusions, but his zeal, his enthusiasm, his "fanaticism for veracity," his love for nature, using that hackneyed phrase in the sense in which men spoke it when the phrase was new.

Students of Agassiz, notably Scudder, Lyman, Shaler, and Wilder have told us what all this meant, where "the best friend that ever student had" was their living and moving teacher. The friendship implied in this, his worthiest epitaph, rested, not on material air, but on recognition of "the hunger and thirst that only the destitute student knows," the craving to know what really is, which outranks all other human cravings.

Marcou tells us the story of the wonderful work done in the little college of Neuchâtel, without money, materials or prestige, investigating, writing, printing, engraving, publishing, all in one busy hive at a thousand dollars a year, when the greatest of teachers had youth, enthusiasm, love of nature, and love of man as his chief or only equipment. This story was repeated, with variations, at Cambridge, and with other variations by Agassiz's disciples throughout the length and breadth of America.

I heard Agassiz say once, "I lived for four years in Munich under Dr. Döllinger's roof, and my scientific training goes back to him and to him alone." Later, in America, he dedicated his contribution to the "memory of Ignatius Döllinger, who first taught me to trace the development of animals."

This suggests the thought of the heredity in science so ancient or characteristic of the Old School. From Döllinger, Agassiz was descended. From Agassiz, all of the naturalists of the Old School of to-day, all the teachers and investigators who have reached the sixty-year mark, or are soon to reach it. These men, from Joseph Le Conte and David A. Wells, of his first class, through Shaler, Wilder, Putnam, Alexander Agassiz, Hartt, Baird, Walcott, Whitman, Brooks, Snow, Lyman, Clark, William James, Faxon, Fewkes, Garman, down to Minot and myself, the two youngest of the lot, as I remember—Minot venerable already, according to the Boston Press.

It is characteristic of the men of the Old School that they formed schools, that they were centres of attraction to the like-minded wherever these might be. There were no fellowships in those days whereby men are hired to work under men they do not care for and along lines which lead, not to the truth they love, but to a degree and a career. We speak sometimes of the Agassiz school of naturalists, the Gray school of botanists, as in Germany "die ganze Gegenbaurische Schule" of anatomy, "die Haeckelsche Schule" of biology. These may be terms of praise or of opprobium, according to the degree of one's sympathy with that school and its purposes.

To belong to a school in this sense is to share the inspiration of its leader. The Gray school of botanists no longer place the buttercup or the virgin's bower at the head of the list of plants as a typical flower. Gray did this; but this is not an essential in honouring Gray. They begin at the bottom, Darwin fashion, and the honour of the end of the list is given to the specialised asters and mints, or the still wider wandering orchids, the most eccentric, the most remotely modified, no longer to the typical, the conventionally simple. In this there is a tacit assumption that Gray would have done the same had he possessed the knowledge which is now the common property of his students. Probably he would; but that matters nothing, for each one follows his own individuality.

The characteristic of the Agassiz school was the early and utter discarding of the elaborate zoological philosophy which the master had built up. The school went over bodily to the side of Darwin, not because Darwin had convinced them by his arguments, but because their own work, in whatever field, led them to the same conclusions. No one who studied species in detail could look an animal in the face and believe in the theory of special creation. The same lesson came up from every hand, and we should not have been true to the doctrines of the master if we had refused faith to our own experience. When the Museum of Comparative Zoology was finished, Haeckel is reported to have said, perhaps in envy, perhaps in jest, that "the output of any scientific establishment is in inverse ratio to the completeness of its equipment." In other words, the more men have to do with the less they would do.

Statistics show that in this paradox there is at least a grain of truth, and this grain of truth stands at the base of my own misgivings. With the scantiest of equipment much of our greatest work has been done. It is said that Joseph Leidy's array of microscopes and knives cost not less than a hundred dollars. The "Poissons Fossiles" was written when its author lived from hand to mouth in the Latin Quarter of Paris, copying "on the backs of old letters and on odd scraps of paper the books he needed, but which he could not buy." Since Haeckel said the words I have quoted, if he ever said them, facilities for biological work have multiplied a thousand-fold. Every German university, Jena with the rest, and most American universities as well, have a far greater equipment than the Museum of Comparative Anatomy had forty years ago. Victor Meyer is reported to have said that the equipment of every chemical laboratory should be burned once in ten years. This is necessary that the chemical investigator should be a free man, not hampered by his outgrown environment. In like vein, Eigenmann has said that when an investigator dies all his material should be burned with him. These should be his creation, and he should create nothing which he cannot use. These could be useful to none other except as material for the history of science. Therefore, too much may be worse than too little. The struggle for the necessary is often the making of the investigator. If he gets what he wants without a struggle, he may not know what to do with it.

But facilities do not create. The men who have honoured their universities owe very little to the facilities their universities have offered them. Men are born, not made. They are strengthened by endeavour, not by facilities. *Facilis descensus.* It is easy to slide in the direction of least resistance. That direction is not upward. It is easy to be swamped by material for work, or by the multiplicity of cares, or by the multiplication of opportunities. I may be pardoned for another personal allusion. I have spent the best portion of my life in the service of science, but for the most part not in direct

service. I have tried to help others to opportunities I could not use myself. I have been glad to do this, because that which I might have done has been far more than balanced by the help I have been able to give to others.

But it is not clear that this greater help has led to greater achievement. I cannot find that the output bears any direct relation to the means for producing it. The man who is born to zeal for experiment or observation cannot be put down. He is always at it. Somewhere or somehow he will come to his own. No man ever adds much to the sum of human knowledge because the road is made easy for him. Leisure, salary, libraries, apparatus, problems, appreciation, none of these will make an investigator out of a man who is willing to be anything else. There is human nature among scientific men, and human nature is prone to follow the lines of least resistance. It takes originality, enthusiasm, abounding life, to turn any man from what is easily known to that which is knowable only through the sweat of the intellect. Of all the men I have tried to train in biology, those five I regard as ablest because their contributions to science have been greatest, were brought up out of doors or within bare walls in which books, specimens, and equipment were furnished from the scant salary. A struggling teacher, a very young teacher at that, at 1800 dollars per year, and 10 per cent. of this for a biological library, is not a condition to attract advanced students to-day, but, so far as my own experience has gone, I have never known stronger students than those who came to me to be trained under these pinching conditions.

To-day the conditions are adjusted to the promotion of the docile student rather than the man of original force. He goes, not to the man, but to the university. He finds work in biology no longer a bit of green sod under the blue sky shut off by conventional and ugly hedges, and therefore to be acquired at any cost. It is a park, open on every side to anybody. Or, dropping the poor metaphor, he finds his favourite work not a single hard-won opportunity in a mass of required language and mathematics. He finds the university like a great hotel with a menu so varied that he is lost in the abundance. His favourite zoology or botany is not taught by a man. It is divided into a dozen branches, each taught by an instructor who is a cogwheel in the machine. The master under whom he would seek inspiration is busy with the planning of additional cogwheels or the oiling of the machinery. Or, more often, there is no master teacher at all. The machinery is there and at his hand. He has but to touch the button and he has alcohol, formal, xylol, or Canada balsam—whatever he needs for his present work. Every usable drug and every usable instrument is on tap; all we need, degrees and all, are made for us in Germany. Another button will bring him all the books of all the ages, all the records of past experience, carrying knowledge far ahead of his present requirements, usually beyond his possible acquirements. The touch of personality, the dash of heredity, is lost.

Worse than all this, for the student who is worth while will orient himself even among the most elaborate appliances and the most varied concourse of elective, is the fact that he is set to acquire training without enthusiasm. Sooner or later he receives a fellowship in some institution which is not the one to which he wishes to go. Virtually, he finds himself hired to work in some particular place not under the man, of all men, he has chosen to know. He is given some petty problem; it seems petty to him and to others. He takes this as his major, with two convenient minors, and at last he is turned out with his degree to find his own life, if he can, with his degree. His next experience is to starve, and he is not so well fitted for this as he would have been had he begun it sooner. If he finds himself among facilities for work, he will starve physically only. If he marries, he starves in good company, but more rapidly and under greater stress. If chance throws him into a college without facilities, he will starve mentally also. In any case, he will lament the fact that the university has given him so much material help, so little personal inspiration, and at the end values its product so low, that with all the demands of scholarship and scholarly living his pay is less than that of the bricklayer or the hack driver; for he has attained a degree of scholarship without a corresponding degree of compelling force. His education has not given him mastery of men, because its direction has not been adequately his own.

It is always the struggle which gives strength. Learning or polish may be gained in other ways, but without self-directed effort there is not much intellectual virility. Good pay, like some other good things, comes to the man who compels it. To make oneself indispensable, real, forceful, with a many-sided interest in men as well as in specialised learning, is the remedy for low salaries. As college men, we get all that we are worth on the average. Our fault is that we are in the average. We need more individuality.

In so far as the universities can remedy this, it would lie in the encouragement of men to take their advanced work in actual centres of inspiration. No one university has many such. Let the fellowships lead men to the few. Or let them be travelling fellowships, available at the best centres of inspiration in this or any other country. Or, if the choice among departments be too delicate a matter for university officials to undertake, let the distribution of fellowships be confined to the men who already are on the ground. These men, in one way or another, have shown their confidence, have chosen their master. If the university wishes now to smooth their path to success, it could give pecuniary assistance without hiring them to go where they do not wish to go. There is no nobler ambition for a great investigator than to hope from a school of science to continue his own kind, by his own method, his own inspiration, the contagion of his own love of knowledge. In no way can this be done, save by letting like come to like, by opening the way from his own kind to find the way to their master. In this our present fellowship system is failing, and this failure is showing itself in the cheapening of virility and the cheapening of originality among our doctors of philosophy as compared with our young workers of a generation ago.

An eminent teacher of physics said lately:—

"The numbers of doctors' degrees in physics bear no relation to the eminence of the professors who grant them. They depend solely on the number of fellowships offered, on the number of assistantships available. In the institution which has conferred the greatest number in recent years, almost every one of these is drawn by the stipend offered; scarcely one by the unquestioned greatness of the leading professor."

The primary fault seems to be in our conception of research, which tends to point in the direction of pedantry rather than that of scholarship. Not all professors have this tendency, only those who are neither great scholars nor great teachers. It is, or ought to be, a maxim of education that advanced work in any subject has greater value to the student, as discipline or as information, than elementary work. Thoroughness and breadth of knowledge give strength of mind and better perspective. They give, above all, courage and enthusiasm. With each year, up to a certain point, our universities carry their studies further toward these ends, and the student responds to each demand made on his intelligence and his enthusiasm.

Then research begins, and here the teacher, as a matter of duty, transforms himself into the pedant. Instead of a closer contact with nature and her problems, the student is side-tracked into some corner in which numerical exactness is possible, even though no possible truth can be drawn from the multiplicity of facts which may be gathered.

This sort of research, recently satirised by Prof. Grant Showerman in the *Atlantic Monthly*, is not advanced work at all. It may be most elementary. The student of the grammar school can count the pebbles in a gravel bank to see what percentage of them lie with the longest axis horizontal as easily as the master can do it. That is not research in geology, however great the pains which may be taken to ensure accuracy. The student may learn something. All contact with gravel teaches something of the nature of rocks, as all reading of Plautus teaches something of poetry; all contact with realities gives some reality as a result. Yet there is no result involved in the case above indicated in the investigation itself. We know

that if flat stones are free to fall, the longest axis will approach horizontally, and that is the end of the matter.

Mr. Showerman's suggested comparison of the "prefixes in P to be found in Plautus," "the terminations in T of Terence," and "the sundry suffixes in S," is scarcely an exaggeration of the kind of work assigned to many of our research students. Such work is in itself absolutely elementary. It teaches patience and perhaps exactness, although, where the student finds that error is just as good as truth in the final round-up, he is likely to lose some of "the fanaticism for veracity" which is the central element in the zealous comradery of the extension of human knowledge. So long as the "new work" on which our doctors of philosophy address themselves is found in material rejected by scholars because a study of it cannot possibly lead anywhere, so long will these doctors be neither teachers nor enthusiasts. They will justify the clever sneer as to the turning worm and the graduate student. Elementary facts about raw material is not the advancement of knowledge. They are killing to those who have a capacity for something better. The listing of "Terence's terminations in T" is a type of work which, at the best, bears the same relation to research that forge-work bears to engineering. It is worth while to the engineer to know what it is like and to be able to handle a hammer if need be. Moreover, a hammered-out horse-shoe is an actual reality. But to make a horse-shoe, even one of a form never seen before, is not the final thesis for which the engineer enters the university.

Much of the graduate work in non-mathematical subjects receives an appearance of accuracy from the use of statistics or other forms of mathematics. This seems to make the results "scientific." Mathematics is a science only when its subject-matter is science—when it deals with results of human experience. At other times it is simply a method—a form of logic. A mathematical enumeration, or even a formula, does not give exactness where it did not exist before.

The statistical enumeration of the "prefixes in P" or the pebbles in the bank is held to give the method of research. It teaches patience and accuracy, two fundamental virtues in the progress of science. Patience, perhaps, if the student persists to the bitter end. Accuracy, certainly not. Sooner or later the student will discover that to multiply by ten one of his columns of figures, or to divide another by five, will have no effect on his final conclusion, for there is not going to be any conclusion. He will then learn to supplement his tables by the quicker and more satisfactory method of guesswork. He turns from the methods of pedantry to the method of journalism. At the best, he will find that the less laborious methods known as qualitative have the advantage over quantitative methods, where matters of quantity have no real significance.

No one should begrudge any amount of time or strength or patience spent on a real problem. In that regard, Darwin's attitude towards the greatest of biological problems is a model for all time. But we should believe that there is a problem, and that our facts point towards the truth in regard to it. A fact alone is not a truth, and ten thousand facts may be of no more importance. A horse-shoe is not an achievement. Still less are ten thousand horse-shoes. "Facts are stupid things," Agassiz used to say, "unless brought into connection by some general law." In other words, facts signify nothing, except as the raw material of truth.

A graduate student of an honoured philologist in a great university lately explained her graduate work to me. A chapter in Luther's Bible was assigned to her, another to each of her fellows. This was copied in longhand, and after it all the variant German versions of the same chapter. Her work was to indicate all the differences involved. There may have been something behind it all. The professor may have had in mind a great law of variance, a Laut-verschiebung or Entwickelung of pious phraseology. But no glimpse of this law ever came to the student. More likely, the professor was at his wits end to find some task in German which had never been accomplished before, and which had never before occurred to any German taskmaster. No wonder the doctor's degree is no guarantee of skill as a teacher! Among the first essentials of a teacher are clearness of vision and enthusiasm for the work. This is not cultivated by these methods. It is not even "made in Germany." The "law of time relations of iron and sulphuric acid" may be developed in a year's work by dropping a thousand weighed shingle nails into a thousand test tubes of sulphuric acid, each having the amount requisite to turn the whole into an iron sulphate. The length of the period before each shingle nail disappears and that before the resultant liquid becomes clear can be measured. It may even be proved that the cleaner the nail the more quickly it dissolves. But all this is not chemical research. It gives no wider grasp on the marvellous processes of chemical reaction, and no greater enthusiasm for chemical work or grasp on chemical teaching.

If the counting in Plautus of the prefixes in P is a type of the only sort of research that the classical knowledges permit, then let them go without research. Let them fall back on the charms of Latin verse, the surprises of Latin wit, the matchless power of description of which the Greek language is capable, and the monumental splendour of the oldest of the story-tellers, who brought even the gods into his service. Let literature be literature, and science science, and enthusiasm will precede and follow any real advance in knowledge. Let the student be free to learn, and not to grind. Let him go with the masters of his own free will, not as he is hired by the pedants. As a final result we shall have again schools of thought and action in America, and the doctor's degree will not be a hindrance in the profession of university teaching.

When our graduate work is really advanced work, under men who know the universe in the large as well as in the small, its great movements as well as its forgotten dust heaps, we shall have our American schools of science, and the Darwins will again "walk with Henslow" over fields as green as were ever those of Cambridgeshire.

With the failure of the enthusiasm of the teacher we have a lowering of ideals on the part of students. They come too often to look on science as a career rather than as an opportunity, to do that which in all the world they would rather do, that which they would die rather than leave undone. Too often, in the words of John Cassin, "they look upon science as a milk cow rather than as a transcendent goddess."

The advent of the elective system, thirty years ago, bore a wonderful fruitage. Men, soul-weary of drill, turned to inspiration. Teachers who loved their work were met by students who loved it. The students of science thirty years ago came to it by escape from Latin and calculus with the eagerness of colts brought from the barn to a spring pasture. In regions of eternal spring these colts do not show this vernal eagerness. Now that science is as much a matter of course as anything else, there is not this feeling of release; and the feeling that one to whom the secrets of the woods and hills, the story of the sea and the rocks, have been made known, belongs to a chosen class, disappears when these matters are made open to everyone. Scientific knowledge, as the result of continued endeavour and of persistent longing, is more appreciated than when it comes as an open elective to all who have completed English 3 and Mathematics 5.

In one of the poems of James Whitcomb Riley this sentence is expressed :—

> "Let's go a visiting back to Grisby's Station,
> Back where we used to live, so happy and so poor."

"So happy and so poor" the American college once was that the student, the teacher, and nature were all together, all hand in hand. It was this which made at Munich the "Little Academy," concerning which Agassiz once spoke so eloquently. It was the contrast with greatness in the most simple surroundings that gave the school at Penikese its unique position. As to this school, I once used these words :—

"With all appreciation of the rich streams which in late years have come to us from many sources, and especially from the deep insight and resolute truthfulness of Germany, it is still true that 'the school of all schools

which has had most influence on scientific teaching in America' was held in an old barn on an uninhabited island, some eighteen miles from the shore. It lasted for three months, and in effect it had but one teacher. The school at Penikese existed in the personal presence of Agassiz; when he died, it vanished!"

Contact with great minds is not so common to-day as it was when the men of the Old School were the leaders of the new. The enthusiasm of struggle, the flash of originality, grows more rare as our educational machinery becomes more perfect. If our present system fails, it is in the lack of personal contact and personal inspiration. If we cannot create new Darwins, the raw material being found, it is because they cannot walk with Henslow. Henslow is somewhere else, perchance in some Government bureau of science, or, if he is present, he has too much on his mind to be a good walker. We do not value him enough to make him free.

We have too much university in America, and too much of what we have in boys' schools. The university as such is a minor affair, an exotic attachment. Should a great teacher, a real man of God, of the God of things as they are, arise in the faculty, he becomes a department executive. More than half his students are of gymnasium grade, and nine-tenths of his teaching is done by young men, men who have not made their mark or who have made it only as cogwheels in the machine. Too often these are caught in the grind, and are never able to show what they might have been if their struggles had been towards higher ends. Smith teaching Zoology 10; Brown, Botany 7; and Robinson, Geology 3, cannot lead their students or themselves to look on nature in the large or to see the wonderful vistas beheld by a Lyell or a Rumboldt. The university in America is smothered by the college. The college has lost its refinement of purpose through coalition with the university. The two are telescoped together, to the disadvantage of both. The boy has the freedom and the facility of the university when he can make no use of it. The university man is entangled in the meshes of the college. University facilities we have enough for ten times—twenty times—the number of students. We go into the market to hire young men to avail themselves of them. There is no corresponding emphasis laid upon men, and men of the first rank are no more numerous to-day than they were in the days of Agassiz, Lowell, Longfellow, Gray, Holmes, Dana, Silliman, Gibbs, Leidy, Goodwin, Angell, White, and Goldwin Smith.

It is the man who makes the school, and completes the chain of heredity from the masters of the last century in Europe to the masters of the twentieth century in America. Excellent as our facilities are, complete as are our libraries, our laboratories and our apparatus, easy as is our access to all this, we have only made a beginning. Another ten years will see it all doubled. What we have is far from complete. But the pity of it is, our students will not guess its incompleteness. Half as much or ten times as much, it is the same to them as the doubling of the bill of fare at the Waldorf-Astoria would be unnoticed by the guests. A still greater pity is this, even the teachers will not know the difference. They can use only what they have time and strength for. The output is no greater for the helps we give. The greatest teacher is one who is ruler even over his books, and who is not smothered by them.

Enthusiasm is cultivated by singleness of purpose, and in our system we make provisions to distract rather than to intensify. There is a learned society, to which many of us belong, Sigma XI. Its value depends on its ability to make good its motto, Spoudon Xynones, "Comrades in Zeal." We whistle to keep up our courage in the multitude, not of dangers, but of distractions, and if we whistle in unison we may keep step together. This society in a cooperative way, the same spirit in different places, stands for enthusiasm in science. Now enthusiasm comes from struggle, from the continuous effort to do what you want to do, and for the most part in the way you want to do it. Hence comradery in zeal should make for individuality, for originality.

The most serious indictment of the "new school" in science is its lack of originality. Even its novelties are not original. They are old fabrications worked over, with a touch of oddity in the working. The requirements for the doctor's degree tend to curb originality. But these do not go far. A man may be original and even in a dress coat in the daytime may be rated as *summa cum lauda*. The greatest foe of originality is timeliness. Rather, timeliness is evidence of lack of originality, of lack of individual enthusiasm.

When a discovery is made in botany the young botanists are drawn to it as herrings to a searchlight, as moths to a lantern. In Dr. Coulter's words, "they all dabble in the same pool." Not long since the pool was located in morphology; then it was in embryology; then in the fields of mutative variations; now it is filled with unit characters and pedigreed cultures.

I would not underrate any of these lines of work or any other, but I respect a man the less when I see him leaving his own field to plunge into one which is merely timely, into one in which discovery seems to be easy, and the outlook to a career to be facilitated.

All honour to the man who holds to his first love in science, whatever that may be, and who records his gains unflinchingly, though not another man on earth may notice what he is doing. Sooner or later the world of science returns to every piece of honest work. The revival of the forgotten experiments of the priest Mendel will illustrate this in passing. Hundreds of men are Mendelians now who would never have thought of planting a pea or breeding a guinea-pig had not Mendel given the clue to problems connected with these things.

The man of to-day, busied with many cares, looms up smaller than the man of the Old School who walked with Henslow and then walked with nature. In this thought it is easy to depreciate our educational present.

Homer, referring to the Greeks of earlier times, assures us "There are no such men in our degenerate days." I have never verified this quotation—the men of our days are too busy to verify anything—but we may take the sentiment as characteristic. From the days of Homer until our own time, the man of the Old School has always found the times out of joint. Perhaps in getting so elaborately ready we are preparing for a still more brilliant future. It may be that books, apparatus, material, administration, and training are all worth their weight in men, and that modern educational opportunities are as much better than old ones as on the surface they seem to be. I know that all these misgivings of mine represent no final failure. Each generation has such doubts, and doubts which extend in every direction. The new strength of the new generation solves its own problems. The new men of the new schools of science will master the problems of abundance and of distraction even as ours solved the problem of hostility and of neglect. The man is superior to the environment, and the man of science will do the work he loves for the love of it. In this love he will develop the abundance of life in others as in himself, and this is the highest end of all our striving.

The atmosphere of a great teacher raises lesser men to his standard. It perpetuates the breed. It was not books or apparatus that made Döllinger or Agassiz or Brooks successively centres, each of a school of research. It was the contagion of devotion, the joy of getting at the heart of things, the love of nature, the love of truth. Sometimes, in our wealth of educational opportunity, we long for the time when, as of old, the student had the master all to himself, the master unperplexed by duties of administration, not called hither and thither by the duties of his station, but giving himself, his enthusiasm, his zeal, and his individuality to the student, not teaching books, but how to make books our servants, all this time master and student struggling together to make both ends meet, and sometimes succeeding, "so happy and so poor." So it was in the old time, and so it shall be again when the new demands and the new wealth find their adjustment. And to find this we shall not go back to Grigsby's Station, nor yet to Penikese; for the scholars that are to be shall rebuild the American universities in their own way, as the scholars of to-day are restoring the University of Cambridge, and in a greater or less degree all other universities in all other lands where men know and love the truth.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

London.—A large number of university courses of advanced lectures in science subjects are in progress or announced. In botany, a course of ten lectures on the history of British botany will begin on January 20 at University College. The first lecture of the course will be by Mr. Francis Darwin, on "Stephen Hales," and the work of other famous botanists will be described in later lectures, the lecturers being Profs. Vines, Bower, Farmer, Lang, Oliver, Scott, Dr. Arber, Mr. Praeger, and Mr. Henslow. Dr. W. N. Shaw, reader in meteorology, will begin a course of eight lectures on climatology, with special reference to British possessions, on the same day at the London School of Economics. Several courses of advanced lectures in physiology are announced. Prof. E. A. Minchin will begin a course of twenty-one lectures on the protozoa at the University on January 16 at 5 p.m. A course of three lectures on the comparative anatomy of the vertebrate ear, by Mr. R. H. Burne, will begin on January 19 at the Royal College of Surgeons. The times of the lectures in each case will be 5 p.m., and admission will be free, without tickets.

During the temporary absence of Prof. Starling, F.R.S., owing to ill-health, Dr. W. M. Bayliss, F.R.S., has been appointed acting professor of physiology in University College, London.

It is announced in *Science* that Harvard University is to receive 12,000*l.* from the will of the late Mrs. William O. Moseley, and that a gift of 100,000*l.* has been made to Dartmouth College by Mr. Edward Tuck.

The degree of D.Sc. as an external student has been granted to Arthur Slator, of University College, Nottingham, and Birmingham and Leipzig Universities, for a thesis on "Studies in Fermentation," and other papers.

We learn from *Science* that, as a memorial to her husband, Mrs. Edward H. Harriman, of New York City, has endowed with 20,000*l.* the chair in forest management in the Yale Forest School. Mr. Andrew Carnegie has agreed to give to the Maria Mitchell Memorial Association a sum of 2000*l.* toward the establishment of a research fellowship in astronomy, on condition that the sum of 1000*l.* required to complete the fund of 5000*l.* be subscribed. The progress made in ascertaining the approximate value of the Wyman bequest for the Graduate College of Princeton University confirms the original estimate of between 400,000*l.* and 600,000*l.*

A course of six free public lectures is to be given at University College, Gower Street, W.C., by Lieut.-Colonel Ernest Roberts, introductory to the study of Indian sociology, on Tuesdays at 4.30 p.m., beginning on February 21 next. A course of eight lectures, free to all internal students of the University of London, is to be given by Dr. H. H. Dale in the Physiological Institute, University College, on Fridays at 4.30 p.m., commencing on January 20. The London County Council has arranged two courses of ten lectures for teachers, which are free to London teachers, to be given on Wednesdays at 6 p.m., beginning on January 18, at University College. One course is on scientific reasoning and its cultivation, the lectures being given by Dr. A. Wolf, and the other on models to illustrate the geometry of space, the lectures being given by Dr. L. N. G. Filon, F.R.S.

The Philosophic Faculty of the University of Marburg has conferred the degree of Doctor Honories Causa upon Mr. Ernst Leitz, of Wetzlar, the principal of the well-known firm of manufacturers of microscopes, microtomes, and other optical and scientific instruments.

SOCIETIES AND ACADEMIES.

London.

Faraday Society, December 13, 1910.—Mr. F. W. Harbord in the chair.—J. **Swinburne**: Separation of oxygen by cold. The problem of separating oxygen from the air is not the same as making liquid air. To separate oxygen from nitrogen involves doing mechanical work, which is converted into heat. A rectifying plant may be considered as an apparatus, which takes in heat substantially at the boiling point of the liquid with highest boiling point, and gives it out at a lower temperature near the boiling point of the most volatile liquid. An air separator thus takes in heat at 90° A, gives out heat at about 82° A, and at the temperature of the works, say, 273° A. The Linde process may be regarded as a rectifying plant of this sort, and a thermodynamic engine, in which a gas is compressed so as to liquefy at 90° A under pressure, and to evaporate at 82°, thus supplying the heat at the boiling point of oxygen and absorbing it at the boiling point of the air. Such a process is generally considered irreversible, but is, in fact, nearly reversible, and therefore economical. Assuming an efficiency of 40 per cent., the cost of oxygen comes out approximately 1*s.* a ton on a large scale. This ought to lead to its use in blast furnaces and other cases where an extra high temperature may be important.—Dr. H. J. S. **Sand** and W. M. **Smalley**: A new apparatus for the rapid electro-analytical determination of metals. A glass-frame anode for use with silver and nickel kathodes. In order to reduce the amount of platinum employed, a pair of electrodes has been designed which, while retaining as much as possible the essential features of those previously described, contains as little platinum as possible. The anode has been made largely of glass, so that the total weight of platinum has been reduced to about 5 grams. Special care has been taken in the design to render it as little fragile as possible. For copper determinations a kathode of silver is employed, which has been designed so that it can be made without much difficulty with the facilities usually available in a chemical laboratory. For zinc determinations a kathode of nickel was employed. The results of copper and zinc depositions are substantially as good as those obtained with platinum electrodes. The time required for determining 0·3 gram of copper is about seven minutes. A stand for holding the auxiliary apparatus required in electro-analysis is also described.

Geological Society, December 21, 1910.—Prof. W. W. Watts, F.R.S., president, in the chair.—T. O. **Bosworth**: The Keuper marls around Charnwood Forest. The area under consideration includes the towns of Leicester, Loughborough, Coalville, and Hinckley. The Charnian rocks project through a mantle of Triassic deposits, which once completely covered them. The quarries have been opened in the summits of the buried hills. A quarry is so worked that its outline follows the contour of the buried hill; consequently, the section presents but a dwarfed impression of the irregularity of the rock-surface. On the buried slopes and in the gullies are screes and breccias, and bands of stones and grit are present in the adjacent beds of marl. All these stones are derived only from the rock immediately at hand. Where exposed, the Charnian igneous rocks are deeply weathered and disintegrated, but the same rocks beneath the Keuper are fresh right up to the top. The Keuper marls lie in a catenary manner across the gullies. There has been almost no post-Triassic movement in Charnwood. All the points of contact of any one bed with the Charnian rocks lie on one horizontal plane. The inclination of the strata must, therefore, be due to subsequent sagging. The Upper Keuper deposits accumulated in a desert basin, of which parts were dry and parts were occupied by ever-shifting salt-lakes and pools. In these waters the red marls were laid down. The abundant heavy minerals are garnet, zircon, tourmaline, staurolite, rutile, magnetite. The grains are intensely worn. The quartz-grains are sometimes wind-worn. The false bedding is mainly from the south-west. The ripples indicate prevalent south-westerly winds.—R. L. **Sherlock**: The relationship of the Permian to the Trias in Nottinghamshire. The conformability or unconformability of the Bunter to the Permian has been much discussed, but it is generally considered that there is a small unconformity between them. In this paper, a section on the Great Central Railway near Annesley is described. It shows a gradual passage from the Middle Marl into the Lower Mottled Sandstone. Detailed mapping has confirmed this conclusion. From Nottingham to Mansfield the Middle Marl retains a

uniform character and thickness, but at Mansfield it is apparently absent. At the same place the limestone becomes sandy, forming the Mansfield Sandstone. These two phenomena can be best explained by supposing that a river deposited a sandbar at Mansfield during Permian times. North of Mansfield the Middle Marl becomes normal again. Near Cuckney, the Upper Magnesian Limestone first appears as a very thin bed, and the limestone arises as thin lenticular bands in the passage-bed. It is believed that the Upper Magnesian Limestone and Upper Marl of the northern part of the outcrop are the time equivalents of the Bunter of South Nottinghamshire.

Royal Microscopical Society, December 21, 1910.—Mr. E. J. Spitta, vice-president, in the chair.—W. R. **Traviss**: A small microscope lamp, particularly suited for opaque objects and dark-ground illumination with high powers. The light used was a small inverted incandescent burner carried at the extremity of a short arm, that could be easily moved up and down on a standard. The light could be brought very close to the table or raised to illuminate opaque objects on the stage.—M. J. **Allan**: An easy method of treating printing-out paper (P.O.P.) for all kinds of photography. The author recommends that the prints be washed in a strong solution of salt, then placed in a saturated solution of hypo, after which they are to be washed in running water.—C. H. **Higgins**: A new system of filing slides.—A. A. C. E. **Merlin**: The measurement of Grayson's new ten-band plate. The plate, comprising ten bands running from 1/1000th to 1/10,000th of an inch, had been ruled by an improved machine, and was found to be much better even than Grayson's earlier productions. The author in measuring the bands used a selected objective of 1·32 N.A., having an initial magnification of 143 on a 10-inch tube. A Nelson-Powell screw setting micrometer, which is alone suitable for the purpose, was used. The result obtained was that the variation from the mean in the spacing of the lines did not exceed 1/230,000 inch. The mean diameter of the lines was 0·00002488 inch. The author also made a series of measurements with 1-inch, ½-inch, and ¼-inch objectives, and came to the important conclusion that low powers were unsuited for micrometry.—Jas. **Murray**: Some African rotifers—Bdelloida of tropical Africa. Thirty-three species of bdelloids were obtained from dried moss sent by Mr. A. Allan and Sir Philip Brocklehurst from British East Africa. Nine of the species are new to science. Several of them have very distinct characters not previously noted for any bdelloids. *Harbrotrocha caudata* has a tail-like process, the function of which is unknown. The animal secretes a protective shell, and the "tail" is enclosed in a slender tube open at the end, so that the shell has two openings. *H. acornis* has no trace of spurs, otherwise universal in the order. Several other species approach it in this respect, having the spurs reduced to minute papillæ. *H. auriculata*, when feeding, has at each side of the head a peculiar ring-like auricle, giving it the appearance of a two-handled vase. The nature and function of the auricles remain unknown. Their form, even, is difficult to interpret, as they present apparently contradictory appearances from different points of view. The bdelloids take a very important place in moss-faunas. In every country they are abundant, and in most regions there is a fair proportion of peculiar species. When more fully known the bdelloids seem likely to prove a group of hitherto unsuspected importance, both in point of numbers and diversity of forms. All these moss-dwellers can revive after desiccation. The adult animals become dormant when deprived of moisture, and revive when remoistened. It is not, as Zacharias concluded from his experiments in 1886, that the survival of the species is effected by means of eggs.

MANCHESTER.

Literary and Philosophical Society, December 13, 1910.—Mr. Francis Jones, president, in the chair.—Miss Margaret C. **March**: Preliminary note on *Unio pictorum*, *U. tumidus*, and *D. cygnea*. The form of the British unionids can be shown to be dependent on current and soil, and is therefore useless for systematic purposes when taken alone. The umbonal markings of these animals merge into one another, and are therefore useless specifically. Phylogenetically, they show that *U. pictorum* is most archaic, *anodon* least, *tumidus* being intermediate. The edentulousness of American anodons illustrates heterogeneric homæomophy. The ornament and dentition of unionids show relationship to trigonids, and a descent from a pre-trigonid ancestor.—D. M. S. **Watson**: Notes on some British Mesozoic crocodiles. The author discussed some systematic and nomenclatural difficulties, recording the occurrence of a new variety of *Metriorhynchus hastifer* in the Corallian of Headington, of *M. hastifer* itself in the Kimmeridge Clay of Britain, and discussed *Petrosuchus laevidens* and *Steneosaurus stephani*.—Prof. F. E. **Weiss**: Sigillaria and Stigmariopsis. The author exhibited some specimens of axes of Sigillaria associated with stigmarian bark. From the repeated occurrence of these specimens it was suggested that they represented the base of the aërial or the subterranean axes of Sigillaria, probably of the Eusigillaria type. The secondary wood was more copiously developed than is general in the aërial axes. The primary wood was of sigillarian type, so that these stigmarian axes have centripetal primary wood, and their pithcasts would be striated like those described for Stigmariopsis. It was noticed that in some instances small axes were found in contiguity, and apparently in continuity, with the main axes. These smaller axes resemble the ordinary stigmarian axes very nearly, and do not show the centripetal primary wood of the main axis, but only a few fine tracheids in the pith region.

PARIS.

Academy of Sciences, January 3.—M. Armand Gautier in the chair.—The Fanny Emden prize (3000 francs). This prize will be awarded for the current year for the best work dealing with hypnotism, suggestion, and generally physiological actions capable of being exerted at a distance from the animal organism. In the special circumstances, memoirs on this subject will be received up to June 1.—M. **Bertin**: The general laws of accelerated or retarded motion of a ship following on a change in the power of the engine. The formulæ developed from theoretical considerations are compared with experimental results obtained by the vessel *Patrie*; the agreement is satisfactory.—Pierre **Termier**: Remarks on the geological map of the Alps.—M. **de Forcrand**: The thermochemical study of some binary compounds of the metals of the alkalies and alkaline earths. A table is given, summarising recent determinations by various authors, giving the heats of solution and formation of the chloride, bromides, iodides, and fluorides of lithium, calcium, strontium, barium, sodium, potassium, rubidium, and cæsium, and some general conclusions are drawn based on these data.—Ernest **Esclangon**: A rotating governor for fixed or variable velocity. The method of regulation, described and illustrated, has been designed for the control of meridian and equatorial telescopes. It permits of easy regulation when in actual motion.—G. **Tzitzéica**: The W congruences.—Michel **de Domeczky**: The theory of symmetrical functions.—C. **Popovici**: Stable permanent movements.—Leinekugel **le Cocq**: The general theory of two indeformable suspended solids, from which are derived formulæ applicable to all systems of rigid suspension bridges.—O. **Boudouard**: The testing of metals by the study of the damping of vibratory movements. Details of experiments on specimens of iron and steel containing up to 1·0 per cent. of carbon, and the thermal treatment of which is exactly determined.—C. E. **Guillaume**: The definition of the practical electrical units.—A. **Lebedeff**: The extraction of zymase by simple maceration. A simple method is described of obtaining zymase not requiring the use of costly materials.—L. **Bruntz** and L. **Spillmann**: The physiological significance of the vital coloration of leucocytes. The so-called vital coloration of leucocytes appears to represent, as in phagocytosis, a defensive physiological action, and this general phenomenon is carried out both in vertebrates and invertebrates by identical processes.—Henry **Pénau**: The cytology of *Bacillus megatherium*.—D. **Roudsky**: The possibility of rendering *Trypanosoma lewisi* virulent for other rodents besides the rat.

NEW SOUTH WALES.

Linnean Society, November 30. 1910.—Mr. C. Hedley, president, in the chair.—Dr. R. **Greig-Smith**: The permanency of the characters of the bacteria of the *Bacillus coli* group. Twelve races of bacteria of this group, upon their isolation from rachitic stools, showed diverse cultural characters. They were cultivated for seven months, and again examined. The activities towards dextrose and mannit were found to be the most permanent. The permanency of the other characters was lactose, neutral-red, motility, milk, growth on gelatin, saccharose, the power of fermenting, which is easily acquired and presumably easily lost.—Dr. R. **Greig-Smith**: Contributions to our knowledge of soil fertility. Part i.: The action of wax solvents and the presence of thermolabile bacteriotoxins in soil. Water extracts from soil a substance which is filterable through porcelain and toxic to bacteria. The toxin is destroyed by heat, by sunlight, and by storage. It disappears from air-dried soil, and decays in aqueous solution. It is not destroyed by salts such as sodium chloride or potassium sulphate. Soils vary in the amount of toxin they contain, good soils containing less, poor soils more. The particles of soil are covered or "waterproofed" with soil-wax or "agricere," which consists of a mixture of saponifiable and unsaponifiable bodies. With the removal of the "waterproofing," the soil nutrients are more easily dissolved by soil water and attacked by bacteria.—W. W. **Froggatt**: Notes on fruit-flies (Trypetidæ), with descriptions of new species. Fifteen species, referable to the genera Ceratitis, Dacus, and Rioxa (Trypeta), are treated, including seven new.—T. G. **Sloane**: Carabidæ from Dorrigo, N.S.W. With an appendix: Tenebrionidæ from Dorrigo, by J. H. **Carter**.—W. M. **Carne**: Note on the occurrence of a limestone fauna at Grose Valley, Hawkesbury district.—R. J. **Tillyard**: Some remarkable Australian Libellulinæ. Part iii.: Further notes on *Camacinia othello*, Tillyard. The female, not before known, is described, and a figure of its wings given. The range of the species is extended from Cooktown to Torres Straits and Port Darwin. An intermediate form, from the Aru Islands, connects this species with the Malayan and East Indian *C. gigantea*, Brauer.—T. T. **Flynn**: Contributions to a knowledge of the anatomy and development of the Marsupialia. No. 1. The material investigated was furnished by an adult female Thylacinus with three advanced young in the pouch. The external features of the young are described, together with the genital organs of both the adult and the young.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 12.

ROYAL SOCIETY, at 4.30.—The Absolute Expansion of Mercury: Prof. H. L. Callendar, F.R.S., and H. Moss.—The Density of Niton (Radium Emanations) and the Disintegration Theory: Dr. R. W. Gray and Sir W. Ramsay, K.C.B., F.R.S.—The Charges on Ions in Gases, and some Effects that Influence the Motion of Negative Ions: Prof. J. S. Townsend, F.R.S.—The Distribution of Electric Force in the Crookes Dark Space: F. W. Aston.—The Measurement of End Standards of Length: Dr. E. P. Shaw.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Adjourned discussion*: Submarine Cables for Long Distance Telephone Circuits: Major W. A. J. O'Meara, C.M.G.

MATHEMATICAL SOCIETY, at 5.30.—A Property of the Number 7: T. C. Lewis.—A Mode of Representation of an Electromagnetic Field as due to Singularities Distributed over a Surface: Prof. H. M. Macdonald.—On the Fundamental Theorem in the Theory of Functions of a Complex Variable: Dr. W. H. Young.—On the Fundamental Theorem relating to the Fourier Constants for given Functions: Prof. E. W. Hobson.

FRIDAY, JANUARY 13.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Verification of the Centre Yard and Three Centre Feet on the R.A.S. Tubular Scale: H. B. Darling.—(1) Proper Motion of Small Star near 17 Lyræ; (2) Measures of a Faint Proper Motion Star: S. W. Burnham.—Periodic Discordance between the R.A's. of the Fundamental Catalogues and those of the Greenwich Standard Clock Stars: W. G. Thackeray.—Micrometical Measures of Double Stars: Rev. T. E. R. Phillips.—Observations of Halley's Comet: J. Tebbutt.—An Adjustable Compensation for an "Invar" Pendulum: R. Inwards.—A suggested method of Determining the Stellar Brightness of a Faint Comet: H. Knox Shaw.—(1) The Magnitude Equation of the Mean Greenwich Observer, from Comparison of Greenwich Standard R.A's. of Clock Stars for 1900 with Boss's Preliminary General Catalogue; (2) Standard Mean R.A's. of Clock Stars for 1860, based on 12-hour Groups from Greenwich Transit Circle Observations in 1853–67: W. G. Thackeray.—*Probable Papers*: The Bearing of the Principle of Relativity on Gravitational Astronomy: W. de Sitter.—Nova Lacertæ (Espin): F. A. Bellamy.

MONDAY, JANUARY 16.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The *Michael Sars* North Atlantic Deep Sea Expedition: Sir John Murray, K.C.B., and Dr. Hjort.

TUESDAY, JANUARY 17.

ROYAL INSTITUTION, at 3.—Heredity: Prof. F. W. Mott, F.R.S.

ROYAL STATISTICAL SOCIETY, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Dicussion*: (1) The Strengthening of the Roof of New Street Station, Birmingham; (2) The Reconstruction and Widening of Arpley Bridge, Warrington: W. Dawson.

WEDNESDAY, JANUARY 18.

ROYAL SOCIETY OF ARTS, at 8.—The Dutch Labour Colonies: J. C. Medd.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Ordinary Meeting.—At 7.45 Annual General Meeting.—Presidential Address: The Present Position of British Climatology: H. Mellish.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Presidential Address: Prof. J. Arthur Thomson.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, JANUARY 19.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Action of *B. lactis ærogenes* on Glucose and Mannitol. Part II.: G. S. Walpole.—The Pharmacological Action of South African Boxwood (*Gonioma Kamassi*): Dr. W. E. Dixon.—Autoagglutination of Red Blood Cells in Trypanosomiasis: Dr. W. Yorke.—The Transformation of Proteids into Fats during the Ripening of Cheese (Preliminary Communication): M. Nierenstein.—The Action of X-rays on the Developing Chick: J. F. Gaskell.

ROYAL INSTITUTION, at 3.—Recent Progress in Astronomy: F. W. Dyson, F.R.S., Astronomer Royal.

LINNEAN SOCIETY, at 8.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Research Meeting. Neolithic Villages in Thessaly: Messrs. Wace and Thompson.

FRIDAY, JANUARY 20.

ROYAL INSTITUTION, at 9.—Chemical and Physical Change at Low Temperatures: Sir James Dewar, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Modern Electrical Dock-equipment, with Special Reference to Electrically-operated Coal-hoists: W. Dixon and G. H. Baxter.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design and Construction of Reinforced-concrete Arches: G. F. Walton.

CONTENTS.

THURSDAY, JANUARY 19, 1911.

RADIO-THERAPY.

Diseases of the Skin, including Radiotherapy and Radiumtherapy. By Prof. E. Gaucher. Translated and edited by Dr. C. F. Marshall. Pp. xii+460. (London: J. Murray, 1910.) Price 15*s*. net.

A FULL account of the use of X-rays and radium in the treatment of various diseases of the skin is given in this volume. The most recent developments in radium treatment are described by Wickham, Degrais, and Dominici. X-ray treatment is described by Gastou and Zimmern. The illustrations are mostly from wax models in the St. Louis Hospital Museum and from Prof. Gaucher's private collection.

The treatment of vascular nævi by radium is fully described and illustrated. The radium salt mixed with finely powdered sulphate of barium is spread with varnish in a thin layer on a metal plate. The treatment consists in the application of this apparatus to the nævus, the dosage being regulated according to the form and depth of the nævus. In flat nævi large doses may be given by direct application for short periods, the dose being timed to cause a certain degree of curative inflammatory reaction. Another method is to give smaller doses filtered through screens which absorb the less penetrating rays, longer exposures being given in this case. There is no reference in the book to the new method of treatment by the application of sticks of solid carbon dioxide.

In cavernous nævi containing large blood-vessels the doses used must not be sufficient to produce inflammation of the surface. The results are very satisfactory, the nævi being decolorised and levelled, and the final results on the whole better than those obtained by any other known means.

In the treatment of cheloid, or scar tissue tumours, very favourable results are obtained both by X-ray and by radium treatment. Radium is less liable to cause dermatitis, and may therefore eventually supplant the X-rays in the treatment of cheloid.

Coming now to the important subject of the treatment of cancer, the very malignant form of growth known as sarcoma, though occasionally greatly reduced in size by X-ray treatment, is seldom cured, and this treatment should on no account be relied upon where there is any chance of success from operative removal of the growth. Treatment by radium may also be tried, but its value remains to be proved; apparent improvement is frequently obtained by its use.

Coming to the skin cancers, or epitheliomata, electricity may be applied in various ways—the electric spark, X-ray treatment, and fulguration. The electric spark treatment is applied by connecting a naked electrode with a high-frequency resonator. The method has been successfully employed in small epitheliomas of the skin. Its action is mainly destructive, while it has the advantage of promoting repair by cicatrisation. The procedure consists in riddling the diseased tissue with small, very short sparks.

Fulguration is a method of using the sparks from a high-frequency resonator by means of Keating-Hart's special electrode for the treatment of growths which are widely and deeply ulcerated, and too great in extent to be destroyed by the cautery. The operation is painful, and must be performed under local or general anæsthesia. The special electrode consists of a hollow metallic rod sliding in an ebonite sheath, and a bellows for blowing a current of carbonic acid gas or air through the rod to prevent the excessive production of heat. The ulcerated surface is subjected to the action of sparks which are usually 7 or 8 centimetres in length. This causes the blood-vessels of the healthy surrounding parts to contract, while the tumour itself is softened within a few minutes. Surgical treatment is then applied, the softened masses of growth being cut or scraped away. The sparking is then repeated carefully and energetically until all growth has been destroyed. A single application is usually sufficient, but any focus of recurrence must be treated again. The results of this treatment are not so good as appeared from the first accounts of patients treated in this way, and the use of the method does not appear to be extending.

The X-ray treatment of cancer is fully treated, the various forms of apparatus for the production of the high-tension current necessary to excite a Crookes's tube being described. The methods of regulating and measuring the dose are also given in full. The author finishes by stating that

"the most ardent partisans of radiotherapy recognise that the X-rays are not always successful in the treatment of epithelioma. Some epitheliomas are rapidly modified by radiotherapy, while others remain unaffected. In the results published, it is necessary to take into account the age of the tumour, its surface, extent, and depth, its situation as regards accessibility to the action of the rays, and also the technique employed, which varies with different operators. In short, radiotherapy may be used in certain cases on the chance of a successful result, provided it is not employed too late; but we must not have too much confidence in this method."

Radium treatment of cancer is fully described by Dominici.

The properties of the alpha-, beta-, and gamma-rays are described, and also the method of eliminating the less penetrative rays by filtration through sheets of lead of various thicknesses. The salts of radium are used mixed in small or large proportions with a salt of barium (sulphate or bromide). This is mixed with varnish and spread on metal or linen. In some cases discs or square sheets of metal are covered with the varnish containing radium; in others rods are used, the ends of which are bulbous, oval, cylindrical, or spatulate. Applications can thus be made to surfaces of various form or to the interior of passages. Another form of apparatus consists of discs or squares of lint covered on one side with the radium varnish and enclosed at the borders in a metal frame; these can be adapted to the shape of the affected region.

The radio-activity of radium is usually compared with that of uranium. If uranium be taken as the unit the activity of pure radium is two million. In the case of a mixture of radium and barium salts, the

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activity of the mixture is inversely proportional to the quantity of the barium salt. In the treatment of cancerous tumours, apparatus of 500,000 activity are used. Such an apparatus usually contains from 4 to 10 milligrams of powder, consisting of one part of radium salt to three of barium salt. Cancers suitable for radium treatment range from those of small size to those of 20 to 30 square centimetres in area. The apparatus may be used in two different ways, either by the so-called dry method, consisting of short, frequently repeated applications causing resolution of the diseased tissue without external destruction, or the destructive method in which the apparatus is left in place from seven to ten hours, causing extensive destruction of the morbid tissue followed by cicatrisation in eight to ten weeks.

For cancers which extend, deeply filtration of the rays is employed by the interposition of a half to several millimetres thickness of lead. In this way only the ultra-penetrating rays (the gamma-rays and the hardest beta-rays) are allowed to enter the tissues. Long exposures are then given varying from 24 to 120 hours. These ultra-penetrating rays produce very little change in the healthy cells of the part, while they have a selective action on the cancer cells, leading to their destruction. The progress of a successful case is as follows:—After a short time (three to eight days) the tumour commences to diminish in size. Cicatrisation then begins and is completed in two to four weeks, or longer in obstinate cases. In the case of ulcerating tumours, a certain amount of discharge occurs during all the stages. For large and deeply-extending tumours the method of "cross-fire" is usually employed, two or more radium apparatus being applied at different points around the tumour in such a way that the ultra-penetrating rays cross in the depths of the tumour. In this way the deeper parts of a growth can be subjected to the influence of the gamma-rays far more effectively than with a single disc of radium.

The general conclusion is to the effect that most cancerous growths can be reduced in size by the application of radium. Some of the less malignant forms of growth can apparently be cured, while in the more malignant cases the temporary improvement is of short duration, and is followed by further extension of the growth.

The treatment of lupus is described—the method of using sunlight concentrated by means of a large hollow lens formed of two plates of glass 10 or 12 inches in diameter, one of which is flat and the other convex, the cavity being filled with sulphate of copper solution to absorb the heat rays. The use of the electric arc lamp as described by Finsen arose naturally from the solar method, and is now too well known to require description. In the case of both the sunlight and the electric arc it is recognised that the violet and the ultra-violet rays are those principally concerned in the curative action. The mercury-vapour lamp, being particularly rich in violet and ultra-violet rays, is very effective, particularly when a tube of quartz is used in place of glass. It is far less expensive than the Finsen arc lamp, and has taken the place of Finsen lamps for many purposes. X-ray treatment and radium treatment have also been employed in the treatment of lupus. The author considers light treatment the most efficacious, while radium has not been employed long enough for its value to be estimated in the case of lupus.

Ringworm is now almost universally treated with the Röntgen rays. A full account of the technical details of this method is given, and the precautions necessary to prevent injury to the patient. The object of the method is to accomplish the removal of all the diseased hairs from the affected area of the scalp. It is found that a properly applied dose of X-rays results, after a fortnight, in the loosening of the hairs, which then fall out leaving a perfectly bald area which can be readily and effectively treated by antiseptic applications. When there are numerous patches of ringworm scattered over the scalp it is necessary to produce epilation of the entire scalp. For this purpose the scalp is divided into ten or twelve areas which are exposed in turn, care being taken to prevent overlapping, as this would result in the administration of an excessive dose to some parts of the scalp. Dermatitis would appear in the over-exposed portions, and permanent baldness would probably result. After a correct dose the hairs begin to grow anew after two or three months, and the new hairs are free from the disease. By the X-ray method of treatment the cure of a case of ringworm is completed in three months, whereas the older methods of treatment by local applications extended for periods of two years or even longer. In the case of the children of the poor treated in public institutions the saving of public funds that has resulted from the introduction of the X-ray treatment of ringworm has been very considerable, and the advantage to the education of the children is self-evident, for while there are any infected hairs on the head it is necessary for the children to be rigorously excluded from intercourse with other children.

Many other diseases are described in which electrical methods of treatment have been used with success. The methods are now firmly established, and the range of their utility is being defined with ever-increasing accuracy.

A. C. JORDAN.

DEDUCTION AND DENUDATION.

Geographical Essays. By Prof. W. M. Davis. Edited by Prof. D. W. Johnson. Pp. vi+777. (London, Boston, New York, and Chicago: Ginn and Co., n.d.) Price 12s. 6d. net.

PROF. D. W. JOHNSON has done good service to science by editing this collection of the valuable memoirs by which Prof. W. M. Davis has done so much to advance physical geography and improve geographical education. The volume includes twenty-six papers hitherto scattered in twenty-one serials. The first twelve contributions are essays and lectures on geographical pedagogics; the remaining fourteen deal with various principles of physiography. It would perhaps have been more convenient if the two series had been issued separately, for the volume, though containing no plates, is heavy for its size, and while the physiographic essays may be read with great

advantage by advanced students of geology and geography, the educational section is of most use to a different circle of readers. The author's criticisms of teachers and text-books would probably have been better confined to a work expressly for teachers, as it is not always good for the intellectual discipline of students to have their often scanty faith in their instructors still further reduced. Geographical education should, moreover, proceed on such different lines in countries in different stages of development, that its discussion is of more local interest than that of physical problems, which are of universal application. The educational essays should, however, be read by all geographical teachers, who must benefit from their high ideals and valuable practical suggestions.

The fourteen physiographic essays in this volume show the development of Prof. Davis's views on denudation. The earliest in date deals with the rivers of Pennsylvania and New Jersey, and led to his well-known classification of rivers according to their relation to the original slope of the land. The wearing away of the land to a plain sloping slowly to the sea is brought out in two papers on the peneplain and on base level, and they lead to the geographical cycle due to the interaction between uplift and denudation. The course of the geographical cycle in an arid climate is discussed in a memoir first published by Prof. Davis in 1905. Among the other papers included are those on glacial erosion in France, Switzerland, and Norway (1900), on the sculpture of mountains by glaciers (1905), on the mountain ranges of the Great Basin, and on the remarkable instances of river capture in the valleys of the Seine, Meuse, and Moselle.

The most striking feature in Prof. Davis's geographical writings is his devotion to the deductive method. He rejects emphatically the view that geography is to be advanced chiefly "by observation, description, and generalisation." To use those methods only is, he says, to walk on one foot. He claims that invention and deduction are as necessary to geography as to any other science. Many of his valuable results are due to his keen insight and not to his method, which cannot be unduly adopted without altering the position of geography in the circle of sciences. The very name geography implies that the subject is descriptive rather than deductive, although some deduction is required by all schools of geographers. But it has hitherto been found convenient to limit geographical work mainly to observation, description, and generalisation, restricting advanced deductive methods to the special problem of geography—the relation of the earth to man. The subject-matter of geography is so enormous that it seems reasonable as well as convenient that there should be a special science and societies devoted to the mapping and description of the earth as it is, leaving its evolution and explanation to other sciences.

Geology, on the other hand, is a "logos," not a "graphe"! and hence requires a more intimate connection of observation and inference than does physical geography. Much that Prof. Davis calls geography has been generally regarded as geology. The distinction that has been so long established and has worked so well in this country, is shown by Prof. Davis himself to have been accepted also in America; for he is professor of geology at Harvard and not of geography. Most of his physiographic essays are quite appropriate to a geological school, and they have been more read in this country by geologists than by geographers. Four of them were published in geological and six in geographical journals.

Prof. Davis, however, regards geology and geography as essentially the same. "They are parts of one great subject," he says (p. 196). "It is a misfortune that we have no English word to include both geography and geology" (p. 198). "To set them apart" he describes as an "obsolescent system" (p. 204). Prof. Davis, moreover, restricts geology to a minor section of the joint subject; he regards it (p. 37) as the sequence of events in the earth's history, and he regrets that such questions as rock weathering are not included in geography. The geographer must, of course, know some of the elementary facts of geology, as he does of meteorology and physics; but he has so many difficult problems connected with man on the earth that he may conveniently refer the study of complicated physical causes to astronomy, meteorology and geology. The abandonment of the conventional boundary between geography and geology would probably prove ultimately detrimental to both sciences.

The classification of some of Prof. Davis's memoirs as geology instead of geography does not lessen their high value. Probably no living writer has done so much to improve the interpretation of denudation. His deductive method and his keen insight have enabled him in studying the history of river systems to unravel confused tangles of facts, and by skipping intermediate phases to go back to stages of which most geologists thought that no traces could be surely recognised in existing geography. The two chapters on glacial erosion illustrate the advantages and the dangers of the deductive method; for according to some geologists, it has led Prof. Davis to attach undue weight to certain striking features of mountain form, and to overlook features which must be included in a complete explanation. Prof. Bonney's presidential address to the British Association has brought the controversy on glacial erosion to a head. It may be hoped that the authoritative and masterly statements on both sides will lead to an agreement as to the main facts, but no settlement can be expected until the arguments of those who limit the efficacy of glaciers as eroding agents have been directly answered.

J. W. G.

TECHNICAL ORGANIC ANALYSIS.

Allen's Commercial Organic Analysis. Vol. iii., Hydrocarbons, Petroleum, Aromatic Acids, Explosives. Edited by W. A. Davis and Samuel S. Sadtler. Fourth edition, entirely re-written. Pp. x+635. (London: J. and A. Churchill, 1910.) Price 21s. net.

THE original "Allen's Commercial Organic Analysis" had established a place of eminence in all analytical and technological laboratories and was a book—it may be said still is a book—of every-day reference. At the same time the trend of modern

chemistry and the rapid advances which are taking place owing to chemical research and improved methods prevent any book, however well up-to-date on its publication, from holding its place unless it is continually revised. In this respect Allen's book required revision along with other reference books of a similar nature. The work has now been taken up by new editors, and when this is the case one naturally scrutinises somewhat carefully the new edition to ascertain whether real improvements have been made. It must be said at once that the revision of another man's work is much more difficult than to start to write a book *de novo,* and the attempts which one naturally makes to leave in paragraphs untouched which were written ten years ago and incorporate them with new material, the reverse of easy.

The editing is being jointly carried out by Mr. W. A. Davis, of London, and Mr. Samuel S. Sadtler, of America. As British and American methods of analysis are not always quite similar this editorship strikes one as being a wise, but at the same time rather difficult arrangement. The individual sections are, as is always the case in reference books of this nature, written by different collaborators. In this volume Dr. F. C. Garrett deals with hydrocarbons of the aliphatic, olefine, and acetylene series and of tars. This section, also under acetylene, includes the valuation of calcium carbide and a reference to the method of Lunge and Cedercreutz in the *Zeitschrift für anorganische Chemie* is given. The abstract of the method, however, is hardly sufficiently full. Surely such books as the one under review are written to enable the reader to carry out estimations without having to refer to the original literature. We do not mean that all processes for the analysis of a given substance should be given, but surely one—the one the writer of the section considers the best—should be set out in detail. The others need be only briefly referred to, or the references to the original literature given.

The processes of tar analysis differ so considerably in detail in different works and with the various processes of distillation—that is to say, high- or low-temperature distillation—and the quality of the coal, that probably the author is right in giving a more or less general survey of the subject. We think, however, that the tars produced from the water-gas process and coke-oven tar might have been described in greater detail.

Mr. Sadtler has compiled the section on bitumens, and treats of the distillation of petroleum, ozokerite, asphalt, petroleum and shale products, cyclic hydrocarbons from coal tar, coal tar naphtha, and other similar products. This section is fairly full, and occupies 223 pages, that is to say, rather more than one-third of the book. On the whole the section on petroleum oils is very good. The subject is a big one, but most of the ground is covered in a quite satisfactory manner. One can see that the author is largely writing at first hand, and although he quotes many authorities, he usually lets the reader know which he considers is the most trustworthy method to adopt.

Mr. Sadtler is also responsible for anthracene and its associates and for the phenols. The latter section is naturally of great importance owing to the extended employment of phenols and phenolic derivatives for disinfecting and antiseptic purposes. The subject is treated in a broad and comprehensive manner, and deals not only with phenols and creosotes from coal tar, but also from various other sources, such as blast-furnace tar, shale-oil tar, and so on.

Mr. W. A. Davis is responsible for the sections on naphthalene and its derivatives, and phthalic acid and phthaleins, Mr. W. P. Dreaper for gallic acid and its allies, and Mr. Edward Horton for the aromatic acids.

Taken as a whole, the volume has been well brought up-to-date, and will, we think, still maintain its place as an invaluable book of reference in the laboratory, particularly of the technical chemist. Its one fault to our mind is that the authors are apt to be rather too discursive and rather disinclined to put the analytical particulars in a concrete form. The book professes to deal with commercial organic analysis, but sometimes one has to read a very long way before coming to any analytical facts. Of course, it is of great assistance to read all about the properties of the substance, but the exact analytical methods are of the utmost importance.

By these remarks we do not wish to detract from the merits of a most valuable work, but to point out where the succeeding volumes might, in our opinion, be strengthened and made even more valuable.

F. M. P.

TASMANIAN SKULLS.

Dioptrographic Tracings in Four Normal of Fifty-two Tasmanian Crania. By Prof. R. J. A. Berry and A. W. D. Robertson. (Melbourne, Transactions of the Royal Society of Victoria, vol. v., part i.) (Melbourne: Kemp, 1909.)

WITH the death of "Lalla Rhook" in 1876 one of the most interesting of human races passed out of existence. "When we reflect," write the authors of this atlas, "that the Tasmanian aboriginal carried into our own times the primitive culture of Palæolithic man and many of the structural peculiarities of *Homo neanderthalensis* we realise, the scientific importance of the study of Tasmanian remains." They have made by far the largest contribution to the material on which our conception of the Tasmanian race must be based, and made it at a most unexpected period. In his well-known monograph on the Tasmanian race, published two years ago, Sir William Turner gave a detailed list of all the skulls then known, seventy-nine in number, and was of opinion that further additions were unlikely. The authors of this atlas have been successful in finding forty-two hitherto unknown specimens, thirty-three of which they discovered in various private and museum collections in Tasmania, while nine they unearthed from a native burial ground. In preparing and publishing an atlas which contains 212 accurate tracings of these crania, the authors had two objects in view: they wished to make the material thus discovered available for the study of anthropologists throughout the world; they also wished to secure a permanent record of crania which, being chiefly in the hands of private owners, are liable to be lost or destroyed.

The authors have thus rendered a signal service to the cause of anthropology, nor must we overlook the liberality of the Royal Society of Victoria for undertaking the expensive work of publishing these elaborate records. It is especially pleasing to note that a strong school of physical anthropology is springing up in Melbourne, one that is keenly alive to the necessity of studying the native races as they now are, and of securing permanent records of their physical characters.

The publication under review may be described as a craniological monograph of a new type; there is practically no letterpress, no columns of measurements, merely tracings from which measurements may be estimated. In brief, the authors have made a large addition to Tasmanian records, but added nothing to the story of this extinct native race. Very likely they intend to give their interpretations of these tracings when they come to deal with their investigations of the Australian natives. Still, we are of opinion that the scientific value of the present publication would have been greatly enhanced if the authors had included the results of the elaborate study they have made of this new collection of Tasmanian crania.

PHILOSOPHY.

(1) *Wolffsche Begriffsbestimmungen. Ein Hilfsbüchlein beim Studium Kants.* By Prof. Julius Baumann. Pp. iv+56. Price 1 mark.

(2) *Wilhelm von Humboldts ausgewählte philosophische Schriften.* Herausgegeben von Johannes Schubert. Pp. xxxix+222. Price 3.40 marks.

(3) *Fichte, Schleiermacher, Steffens über das Wesen der Universität.* By Eduard Spranger. Pp. xlii+291. Price 4 marks.

(4) *Baruch de Spinoza. Ethik. Siebente Auflage.* By Otto Baensch. Pp. xxxii+315. Price 3.40 marks.

(5) *Encyklopädie der Philosophie.* By A. Dorner. Pp. vii+334. Price 6 marks.

(Leipzig: Verlag der Dürr'schen Buchhandlung, 1910.)

(1) A COMPILATION of Christian Wolff's definitions, by the professor of philosophy at Göttingen. Dr. Baumann made this compilation many years ago, for his own needs, purposely confining himself to the problem of the theory of knowledge. Recently, when re-reading Kant's "Kritik der reinen Vernunft," he took up his compilation and recognised the parallelism with Wolff. This little book is therefore now published as a help to the study of Kant. It contains useful definitions, with references, of terms such as *Empfindung, Vorstellung, Wahrnehmung, Idee, Begriff,* which are the chief elementary difficulties in the way of the student of Kant, and of German philosophical writers in general.

(2) This selection of Humboldt's philosophical writings is intended to spread the knowledge of his many-sided nature and powers among a wider circle of readers than has hitherto been reached. Those who wish to go more deeply into his treatment of the subjects may be referred to the great standard edition of his works, which appeared during the course of last year. The present volume contains chosen specimens on such diverse subjects as Goethe's "Hermann and Dorothea," "Latium and Hellas, or Considerations on Classical Antiquity," "Philosophy of Language," "Philosophy of Religion," the "Bhagavad-Gîtâ," and "Pedagogy." The matter seems, naturally, a little old-fashioned, and the æsthetical parts appeal chiefly to readers who make a special study of the history of German literature. Humboldt was a humanistic philosopher, leaving behind him the individualism and general æsthetic hurly-burly of the "Sturm and Drang" period.

(3) Another book of chiefly historical interest, consisting of reprints of various writings of the three authors named, concerning ideals of university teaching. The centenary of the University of Berlin, which was recently celebrated, gives the suitable occasion. Dr. Spranger furnishes an introduction in which he compares Berlin with other universities. The former

"was born in an hour of great changes: this birth in the living flux of things, permeated with the thoroughly modern spirit, gave her living power, and made her a model to her older sisters, who are but now stripping off the old forms, and growing into the new."

(4) In his "Biographical History of Philosophy," G. H. Lewes said that he never hoped to find foothold in the boundless morass of metaphysics, after he once fairly saw the reasons which rendered Spinozism unacceptable. The present edition of the famous "Ethics" (the seventh in German translation from the original Latin) seems to indicate that there are readers still to be found for the writings of the subtle-minded though intensely spiritual Jew, to whom—as justifiably as in the case of Novalis—the term "God-intoxicated" has been applied. The translator writes an introduction, in which he remarks that "Spinoza's philosophy is the most impressive concentration of the thought of the seventeenth century into a coherent view of the world and of life," even though those times produced Descartes and Leibniz. And modern philosophy, for the most part, will certainly agree.

(5) Dr. Dorner, who is professor of theology at Königsberg, is a follower of Hegel rather than of the great analyst whose name is inevitably recalled by Königsberg. The present volume, which is not an encyclopædia in the English sense, is a metaphysical work dealing chiefly with the theory of knowledge and doctrine of categories. The following sketch will give the author's general attitude.

The progress of philosophy seems the same now as in antiquity. Kant occupies the same position in modern philosophy as Socrates did in the ancient. After Socrates came Plato and Aristotle, to whose systems our modern philosophy of the Absolute corresponds. Then came the Stoics and Epicureans, with a revulsion to the practical side of things. The modern analogue is found in those thinkers who lay emphasis on feeling and will. The chief difference between old and new is, that the subjective side is now much more in the foreground, which tendency shows itself particularly in the importance assigned to psychology. Some, indeed, candidly regard it as the central science. Also, in modern life the empirical

sciences, and history, play a much greater part than in antiquity. Result: mysticism and agnosticism. Prof. Dorner combats both. The physical sciences themselves point the way to metaphysical principles; the problem of philosophy is not merely epistemology or the making of a world-conception out of the disparate elements of knowledge and experience, but is rather the search for a unified metaphysic by which the fundamentals of the world and of the spiritual life may equally be grounded in an Absolute Being.

AMERICAN TEXT-BOOKS OF MATHEMATICS.

(1) *College Algebra.* By Prof. H. L. Reitz and A. R. Crathorne. Pp. xiii+261. (New York: H. Holt and Co.; London: G. Bell and Sons, 1909.) Price 6*s.*

(2) *Trigonometry.* By Prof. A. G. Hall and F. G. Frink. Pp. x+146+93. (New York: H. Holt and Co.; London: G. Bell and Sons, 1909.) Price 7*s.* 6*d.*

(3) *First Course in Calculus.* By Prof. E. J. Townsend and Prof. G. A. Goodenough. Pp. xii+466. (New York: H. Holt and Co.; London: G. Bell and Sons, 1908.) Price 12*s.*

THESE books are the first three of a series which is intended in the first place for students taking a university course in engineering, and also, to a certain extent, for mathematical students. It will be noticed that each book has two authors, who have been selected to represent the interests of readers of both classes.

(1) and (2). The chief novelty in these books is to be found in the variety of examples, selected from very different subjects. Thus, as an example on evaluating algebraic expressions ("Algebra," p. 24), the student is asked to verify in a few cases a formula for the day of the week, which (after an obvious simplification) can be written [1]—

$$2+p+2q+[\tfrac{3}{5}(q+1)]+s+[\tfrac{1}{4}s]-2r+[\tfrac{1}{4}r]\equiv t \pmod{7}$$

where t is the day of the week (Sunday being 1 and Saturday 7), and the date is the pth day of the qth month in the year $100r+s$. The reader interested in such matters may find it instructive to reconstruct this formula, of which the most interesting feature is the part depending on q; it will be found that starting from March (and ignoring February) the lengths of the months recur after intervals of five months, and this is the basis of the formula.

The problems proposed in the trigonometry are chosen so as to illustrate the practical difficulties of surveying so far as possible. Great stress is laid on the advantage of making a *form* for numerical calculations, before starting to use the tables at all. One useful consequence is that, in the typical examples worked out, the logarithms to be added are placed in *vertical* columns, as would be done in practical work; writers of text-books are very apt (in order to save space) to arrange such logarithms *horizontally*. The result is that imitative readers are liable to arrange their work in the same way, with disastrous results.

The last ninety-three pages in the trigonometry contain a good set of five-figure tables. The table of logarithmic functions, however, makes no special provision for finding the log sin and log tan of *small* angles; a very simple rule applies to four-figure or five-figure tables (with a difference of $1'$ in angle), namely—

$$\log\sin\theta=\log\sin\alpha+(\log\theta-\log\alpha)$$

and this (or some similar rule) ought to be given in all tables which do not provide a special table for the first few degrees. The table of squares is interesting, as it gives the *exact* squares from 1 to 1000^2, without occupying more space than an ordinary four-figure table; this is effected by following the arrangement of Crelle's multiplication tables, where every number in the same horizontal line is terminated by the same two digits. Both in the algebra and trigonometry certain of the best-known power-series are given and used for numerical calculations; but the authors of the algebra are content to refer to the calculus (No. 3) for proofs, while in the trigonometry some proofs are provided, which would not be accepted nowadays. It might be better definitely to cut out all such proofs from books on trigonometry; in modern teaching the elements of the calculus are certainly regarded as easier (and more generally useful) than the "calculus-dodging" of the old-fashioned books.

(3) Compared with recent English books having similar titles this book contains fuller treatment of the applications of the calculus to applied mathematics; for instance, centroids, moments of inertia, resultant fluid pressure, are considered at some length, as exercises on integration.

As in the other books of the series, a large variety of illustrative examples will be found; thus the exponential function is connected with the chemical problem of inversion of cane-sugar. The theory of maxima is illustrated by the efficiency of a rough screw, the speed of signalling in a cable, and the h.p. transmitted by a hemp-rope.

In dealing with the Taylor's series derived from a given function, care is taken to point out that the series *may* converge without being equal to the function; this is a point quite commonly overlooked in the theory, and possibly an example would have helped to emphasise it.[1]

As might be anticipated from the character of the series, a good deal of stress is laid on methods for approximate integration, such as Simpson's rules and other similar methods, and several examples are given of their application to irregular solids such as rails. It seems strange, however, that the *exact* form of Simpson's rule is not mentioned, for finding the volume and centroid of a railway embankment (or the slice of an ellipsoid) in terms of the areas of the ends and the area of the central section.

The use of infinite series for finding an integral

[1] The notation is that of the theory of numbers: that is, $[x]$ denotes the integral part of x, and $y\equiv z$ means that $y-z$ is divisible by 7. Note that January and February are regarded as belonging to the *previous* year, with the values $q=13$, 14.

[1] Thus, Pringsheim's function $\Sigma\frac{(-1)^n a^n}{n!(1+x^2a^{2n})}$ has the Taylor's series $e^{-a}-x^2e^{-a^3}+x^4e^{\;a^5}\ldots$: but if $a>1$, although both series converge for all *real* values of x, they are unequal except for $x=0$. For instance, if $a=2$, $x=2$, it will be found that the first series is less than 0·109, while the second is greater than 0·133; on the other hand if $a=\frac{1}{2}$, $x=\frac{1}{2}$, both series are equal to 0·434 (nearly).

is also classed by the authors as "approximate integration"; this is a view which does not seem altogether satisfactory. At any rate, the nature of the approximation involved in using an infinite series is certainly different from that associated with the use of Simpson's rules. Incidentally, at least one example (p. 379), in which the integration is effected by a series $\left(\int\int\{y/(y+c)\}dS\right.$ integrated over a circle), is easily reduced to finite terms in the form,

$$\pi a^2 - 2\pi c\,\{c-(c^2-a^2)^{\frac{1}{2}}\}.$$

Some of the integrals proposed for evaluation by the aid of series are not very easy to evaluate *directly*; for instance (p. 380), the elliptic integrals,

$$\int_0^x \frac{dx}{\sqrt{(\sin x)}} \text{ and } \int_0^1 \frac{dx}{\sqrt{(1-x^4)}}.$$

Both of these can be expressed in various forms, but the series which are more immediately suggested are not very suitable for ordinary calculations; in particular the second of them suggests the binomial expansion of $(1-x^4)^{-\frac{1}{2}}$, but the resulting series is quite hopeless for numerical work. Of course, there are several ways of transforming the integrals before conversion to series; but such transformations might well be suggested in the questions, or the reader may not succeed in guessing what to do first.

In reading the chapters on applications to plane curves one cannot help regretting some of the old-fashioned geometrical types of proof; no doubt the older books contain much that is not only unsound, but incapable of being made sound. But in spite of this, a geometrical treatment is more attractive to the ordinary reader, and in many cases the proofs can be made reasonably accurate by the aid of very little additional analysis.

T. J. I'A. B.

BOOKS ON NATURE-STUDY.

(1) *Der Naturfreund am Strande der Adria und des Mittelmeergebietes.* By Prof. Carl I. Cori. Pp. viii+148+22 plates. (Leipzig: Verlag von Dr. Werner Klinkhardt, 1910.) Price 3.50 marks.

(2) *The Aims and Methods of Nature-Study. A Guide for Teachers.* By Dr. John Rennie. With an introduction by Prof. J. Arthur Thomson. Pp. xvi+352. (London: W. B. Clive, University Tutorial Press, Ltd., 1910.) Price 3*s.* 6*d.*

(1) PROF. CORI'S volume is not intended to give descriptions of the systematic characters and organisation of marine creatures, but rather to be a companion to direct the attention of the nature-student to the more commonly occurring marine organisms and to the chief phenomena associated with them. After a brief account of the past history of the Mediterranean and Adriatic, the author passes to the consideration of the animals of the beach—Arenicola, Sipunculus, Solen, Venus, Echinocardium, Synapta, Carcinus, &c.—the chief features and theoretical points of interest associated with many of which are indicated. While dealing with Annelids, the author directs attention to their relationship to the Crustacea and to the theory of the Annelid ancestry of vertebrates. Modifications of structure correlated with certain habitats, as illustrated, for example, by sessile molluscs, and the habits of animals, *e.g.* the shamming death and autotomy of crabs, are dealt with in an interesting manner. The description of the abundance of life on the beach leads up to remarks on the origin of life in shallow water, "die Geburtsstätte alles Seins." The lagoons and their flora and fauna—Mysidæ, Carcinus, Cardium, Labrax, Anguilla, &c.—and the Zostera meadows, with their extensive and characteristic fauna—Virbius, Spadella, Turbellaria, Cerianthus, Sepia, pipe-fish, sea-horses, &c.—are the subjects of two chapters.

The account of Sepia contains interesting references to the antiquity and former greater abundance of species of Cephalopods in the period when the Ammonites flourished, and to the power of colour change, owing to which "spiegelt sich sozusagen die Seele der Sepia auf ihrer Haut ab." Throughout the volume the author brings before the reader observations on the mode of life, the food and special points in the physiology of the animals under description; for instance, he points out that in Trachinus, the weever-fish, the spreading of the spines and the assumption of the defensive attitude are dependent chiefly on stimulation of the tail. The organisms of the rocks and rock-pools are then considered, attention being given to boring animals, *e.g.* Pholas, Paracentrotus, the former boring by chemical, the latter by mechanical means.

The concluding chapters give accounts of the larger organisms obtained by dredging, and in the plankton (Rhizostoma, some Siphonophores, Ctenophores, and Salps) and on the high sea (fishes, dolphins, &c.). The figures are for the most part excellent, but a few, for instance, those of Aphrodite, Arenicola, and Balanoglossus on Taf. vi., are capable of improvement. A few errors of spelling occur in the names of the animals figured, *e.g. pilleata* (for *pileata*), *forscalea, Litorina,* and *Echineis.* But these are only slight blemishes, and do not seriously detract from the value of this excellent work, which cannot fail to stimulate the interest and imagination of the nature-lovers for whom it is intended.

(2) Dr. Rennie aims at imparting a definite continuity of principle to the teaching of the subject of nature-study and to this end he outlines series of carefully graded courses. He holds rightly that the facts need to be carefully grouped or arranged in sequence, according to principle, in the mind of the teacher (although the principle need not always be enunciated to the pupils), for only in this way can the teaching be effective. Four school courses are suggested, namely, for pupils of seven or eight years, eight or nine years, nine to twelve years, and seniors, all of which are arranged on a seasonal plan and deal in turn with plants, animals, weather studies, calendars, and general considerations. Several chapters are devoted to excellent object-lessons on common living things, *e.g.* frogs and toads, birds and their eggs and feathers, the mole, shells, the snail, caterpillars and moths, earthworms, gnats, buttercups, common fruits and seeds, trees, ferns, &c. Then follow elementary studies of some common rocks, suggestions for a

school garden, studies on insects of economic importance, &c. The lessons are objective and practical, and from the stores of trustworthy information which they contain the teacher can select those topics most applicable to the locality and conditions under which he works. The volume is a plea for care and method, and we can recommend it to those teachers who desire to develop their work in this subject along sound lines. There are 178 illustrations, for the most part good, but several of those of insects might have been more carefully executed.

OUR BOOK SHELF.

An Introduction to Biology for Students in India. By Prof. R. E. Lloyd. Pp. xviii+298+15 plates. (London: Longmans, Green and Co., 1910.) Price 4 rupees (or 5*s.* 4*d.*)

This little book does not pretend to be a complete introduction to biology, and the title is perhaps somewhat misleading. It deals exclusively with certain invertebrate types and certain general principles, and appears to have been designed for the use more especially of Indian medical students. The author tells us in his preface that the book was written somewhat hurriedly, because it was urgently needed. The types dealt with have very properly been selected from the Indian fauna, and the work is evidently based very largely upon personal observations, for which the author deserves due credit. Some of the animals described, such as the fresh-water sponge, the scorpion, and the mosquito, are not usually dealt with in elementary text-books.

The work is of a strictly elementary character, but at the same time suffers somewhat from being rather too much up-to-date. Thus the chapter on heredity is practically confined to Mendelism. The author is not always happy in his definitions. He tells us that "the anterior end of an animal is that at which the mouth opens; the posterior end is where the anus is to be found. But difficulties sometimes arise in using these terms; for example, in a gasteropod mollusc, the mouth and anus open in the same direction." Surely it would be more correct to say that primarily the anterior end is carried foremost when the animal moves about, while the posterior end comes hindmost. It is difficult to excuse the spelling of the word "Foramenifera," and the statement that the shells of these animals are "always perforated by minute round apertures" is very misleading. Another misspelling against which we must protest is "chord," for "cord," in the case of the nerve-cord of Annelids. This is a mistake which is frequently made by elementary students, doubtless on the analogy of "notochord," which, of course, is really a Greek word.

It must not, however, be forgotten that this is a pioneer work written under great disadvantages. It shows a considerable amount of originality, both in scope and treatment, and should prove useful to those for whom it is intended.

A. D.

Botany for High Schools. By Prof. G. F. Atkinson. Pp. xv+493. (New York: Henry Holt and Co., 1910.)

When it is found that a school text-book of botany of average size contains, in addition to a course of morphology dealing with growth and work of parts of the flowering plant, a series of life-histories drawn from all the plant divisions and accessory chapters on ecology, economic plants and plant breeding, the question naturally arises whether careful exposition is not being sacrificed to variety. There are certainly objections to the inclusion of the life-histories from the lower cryptograms, as they are too sketchy to suffice for practical work; also the range and variation are too complex for the ordinary schoolboy or girl, while many teachers would prefer a good course of physiology or a grounding in the classification of vascular plants as an item in training.

Nearly half the book is devoted to the first part, in which the author presents a well-arranged account of the activities of the plant. The morphology of the vegetative organs is not so well ordered, and there are several unsatisfactory passages, such as the confusion between stem and shoot, unacceptable definitions of "decumbent" and parts of a leaf, and a misuse of cambium in describing the stem of the maize plant. The flowers, methods of pollination, and seed dispersal are treated at some length. The later chapters suffer from excess of generality or a tendency to the introduction of specialised topics, but it should be added that it is the author's intention to present outlines that are to be filled in by the teacher's lectures and practical work.

Proceedings of the Aristotelian Society. New series. Vol. x., 1909–10. Pp. 300. (London: Williams and Norgate, 1910.) Price 10*s.* 6*d.* net.

The Aristotelian Society exists for the systematic study of philosophy, as to its historic development, and as to its methods and problems. It is an aristocratic body—intellectually speaking—consisting of about one hundred members, among whom are Mr. A. J. Balfour, Mr. Haldane, Prof. Sorley, Dr. Stout, Dr. Bernard Bosanquet, and Dr. Shadworth Hodgson.

In the latest volume of *Proceedings* there are papers on "Sensations and Images," by Prof. Alexander; "The Subject-matter of Psychology," by Mr. G. E. Moore; "Epistemological Difficulties in Psychology," by Dr. William Brown; "Kant's Account of Causation," by Mr. A. D. Lindsay; "Bergson's Theory of Instinct," by Mr. H. Wildon Carr; "Science and Logic," by Mr. E. C. Childs; "Some Philosophical Implications of Mr. Bertrand Russell's Logical Theory of Mathematics," by Mr. S. Waterlow; and two interesting papers on "Are Secondary Qualities Independent of Perception?" by Dr. Percy Nunn and Dr. F. C. S. Schiller respectively. The former takes up a position of vigorous realism, while the latter, with all his accustomed attractiveness of style—even when dealing with very technical matter—hopes to convince Dr. Nunn that philosophical salvation lies in humanism, for which the old terms idealist and realist have almost ceased to have meaning or interest. Dr. Nunn has a curious and rather novel argument in favour of there being possibly something really "there," in some hallucinations. He instances our old friend the "stick bent in a pool." To the eyes, it is bent, to the touch it is straight; in other words, its visual characters are not in the same position as its tactual. May we not therefore see a real thing which, to our other senses, is elsewhere? It is certainly a suggestive analogy, though risky.

Häusliche Blumenpflege. Eine Anleitung zur Pflege der dankbarsten Zimmer- und Balkon-Pflanzen. By Paul F. F. Schulz. Pp. vii+216. (Leipzig: Quelle and Meyer, n.d.) Price 1.80 marks.

According to the author plant culture in the home is not sufficiently practised in Germany, and the object of the present work is to arouse more interest in the pursuit. Certainly if the plants for which instructions are given can be grown in the house, many having the time and taking a keen interest in flowers would be inclined to try their skill. The list includes Abutilon, Camellia, the Alpenrose, Bouvardia, Clivia, *Monstera deliciosa*, and *Odontoglossum grande*, in addition to the palms, geraniums, hydrangea, Cacta-

ceæ, and other plants that are generally recognised to be suitable for the purpose. The chief essentials to success are carefully prepared soil, good lighting, judicious watering, and, in many cases, an unheated room for winter storage; the good results observable in cottage rooms are quite in accord with the last condition.

The author first instructs in general processes, such as watering, potting, sowing, and the like, and then gives special directions for each plant or group of similar plants, arranging them according to habit. The instructions are full, clear and explanatory, so that anyone with an ambition for cultivating such plants as those named above without a greenhouse will be well advised to consult the book and work upon the lines indicated.

Flashes from the Orient, or a Thousand and One Mornings with Poesy. In four books, Spring, Summer, Autumn, and Winter. Book third, Autumn. By John Hazelhurst. Pp. x+280. (London and Aylesbury: Hazell, Watson and Viney, Ltd., 1910.) Price 1*s*. 6*d*. net.

Readers familiar with Mr. Hazelhurst's sonnets on summer will turn with interest to his verses dealing with subjects suggested by the phenomena and events connected with the fall of the year. His subjects range from "Enthusiasm" to "Misery," and from "The Sewing Machine" to "The Dome of Heaven"; and he finds music in them all.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The Inheritance of Acquired Characters.

I am rather disposed to think that Prof. Judd is right in saying that this "and similar problems were constantly present to Darwin's ever-open mind." They seem to me, indeed, to underlie the whole of the discussions in the second volume of the "Variation of Plants and Animals under Domestication"; and I believe it is generally considered that Darwin put forward his theory of "pangenesis" to account for the cases where some amount of direct influence of the environment appeared to be inherited.

The passage which Prof. Meldola quotes from the sixth edition of the "Origin" occurs word for word in the first (p. 44). It is interesting to note that in the interval between the two Darwin never saw any ground for altering the statement, though he modified others on the same page. I can have little doubt that, at any rate so far as plants are concerned, "the source of his . . . authority for" it is to be found in Alph. de Candolle's "great and admirable work," as Darwin calls it ("Origin," sixth edition, p. 89), "Géographie Botanique raisonnée." That appeared in 1855, and there is abundant internal evidence to show that it received from Darwin the most attentive study.

Great and admirable it certainly is, but it is impossible not to feel in reading it that, perhaps in the whole history of science, there has never been a more striking case of a *coup manqué*. For de Candolle had the same problem before him as Darwin, and he attacks it by the same method of patiently accumulating and sifting facts. He grasps the action of variation, heredity, and of cultural selection, but he fails to grasp the idea that nature might operate on the same lines as the cultivator, and natural selection constantly eludes him as it did Herbert Spencer.

It is true that de Candolle does not absolutely reject the effect of the environment, but he was led to the conclusion that it would act, if at all, with such extreme slowness as to be practically ineffective. It is difficult to give a brief quotation, but the following may suffice:—

"Toutes les fois qu'il a été question de l'influence du climat sur les végétaux, je me sais efforcé de combattre l'opinion d'une *acclimatation*, c'est à dire d'un changement dans la nature des espéces qui les rende, après quelques générations, plus aptes à résister aux influences défavorables d'un climat. J'ai applaudi au mot spirituel de du Petit—Thouars: 'L'acclimatation, cette douce chimère de la culture'" (pp. 1087–88).

It must I think be evident that, though he does not actually quote it, Darwin, from his use of the word "chimæra" ("Variation," ii., 313), has this passage in his mind. But he goes on to show that the problem is at once solved by natural selection. He states this, however, with his usual caution:—"Though habit does something towards acclimatisation, yet . . . the spontaneous appearance of constitutionally different individuals is a far more effective agent" (*loc. cit.*, 314), and though he appears, in the main, to have relied on de Candolle, he took some trouble to investigate the question for himself:—"Can we feel sure that our kidney-beans are not somewhat hardier? I have not been able, by searching old horticultural works, to answer this question satisfactorily."

I think, then, that it was upon de Candolle's conclusions, supported by his own investigations, that Darwin based the pregnant sentence which Prof. Meldola has quoted. And how pregnant every word in the book is can be little appreciated except by those who have more than a bowing acquaintance with its pages.

I cannot but agree with Prof. Judd that modern evolutionary theory had its root in Lyell. Nor do I think that in the cold light of history it will seem to "be going too far . . . to assert that if the Principles of Geology had not been written, we should never have had the Origin of Species." If the possession of Darwin is the glory of Cambridge, it is pleasant for a member of the sister university—though it says little about it—to know that it is secure in that of Lyell.

W. T. Thiselton-Dyer.

Witcombe.

Palæolithic Shaft-straighteners.

In a previous communication to Nature (vol. lxxiv., p. 372, 1906) I directed attention to some Eskimos' arrow-straighteners which present a closer resemblance to the famous *bâtons de Commandement* of the Magdalenian age than any which had been previously described.

Last summer, when my friend Mr. Marrett and I were returning from Toulouse, where we had enjoyed the hospitality of the French Association, we stayed at Perigueux on our way to some of the painted caves of Les Eyzies. We were fortunate in our choice of an hotel, for our host, M. L. Didon, proved to be an enthusiastic investigator of the caves in the neighbourhood. His collection of Aurignacian bone implements, obtained by him from the Aurignacian station of Castelmeule, is the finest I have seen, and, I should think, unrivalled anywhere. M. Didon informs me that he has completed its description, which will be published in the course of the winter.

The number and variety of the bone implements obtained from this single locality, dating from a period so long anterior to the Magdalenian, greatly impressed us, but the objects which most aroused my interest were three shaft-straighteners (see Fig.). These, while presenting a general resemblance to the Magdalenian bâtons, make a still nearer approach to those of the Eskimos previously re-

ferred to. M. Didon was kind enough to allow me to make drawings of them for publication, and in the accompanying figure at B, C, D they are shown side by side with the Eskimos' shaft-straightener described by Dr. Boaz (Franz Boaz, Bull. Am. Mus. Nat. Hist., xv., p. 84, Fig. 117, 1901). They are all reduced to the same scale. The larger holes are no doubt intended to be used upon the shafts of javelins or lances; the smaller ones are of an appropriate size for arrows. The largest hole in A is 24 mm. in diameter, in B 21 mm.; the small hole in C is only 10 mm.

The most important feature in these implements is the obliquity of the holes; their axes are not perpendicular, but strongly inclined to the face of the implement. Singularly enough, in the more artistic *bâton de Commandement* of the Magdalenians this refinement is absent, and the hole goes straight through.

The ridges produced by the drill in boring these Aurignacian straighteners are still preserved, except on two opposite sides of the hole, where they have been worn away by use.

Whatever may be the ultimate verdict upon the Magdalenian "bâtons," there can be no question as to the nature of their Aurignacian homologues, since in no essential feature do these differ from the shaft-straighteners of the Baffin's Bay Eskimos described by Dr. Boas.

A similar straightener has been described and figured by Maška from the Kulna cave near Sloup, in Moravia.

Oxford, January 7. W. J. SOLLAS.

The Turkestan Earthquake of January 3–4.

SOME details of the seismographic and magnetographic records of the great earthquake of January 3 may be of interest to readers of NATURE. The three oscillation phases as seen on the seismogram are comparatively large. They commenced suddenly, each with a westward displacement, at 11h. 37m., 11h. 44·5m., and 11h. 48·5m. p.m. respectively. The large waves (third phase) then continued for 23·5 minutes, producing rapid oscillations of the boom at an average of 35 mm. double amplitude, indicating 14·4″ arc swing of the pillar. But these suffered an early interruption of 5 minutes by an apparent interference of two systems, reducing the amplitude to a minimum at 11h. 54m. p.m. The recovery was immediate and sharp, as if by the arrival of a second train of large waves, resembling closely the effect of the initial shock of the first large waves.

The maximum amplitude may have occurred between midnight and 8 minutes after, during which interval the registering light-spot travelled frequently beyond the limits of the camera aperture. But there is a probability that the maximum occurred precisely at midnight; and this is supplied by the mechanical effects upon the three magnetographs, each of which shows a clear maximum oscillation at midnight.

As on former occasions, the bifilar suspension of the horizontal force magnet was much more sensitive to the shakes than the unifilar declination or the vertical force balance. The bifilar responded to the first preliminary earth-tremors, and did not come to final rest for half an hour. Its record shows two groups of lines. The first contains three clear oscillations, marking the beginning, middle, and end of the first tremors. The second group contains five oscillations, including the maximum; and there is a smaller oscillation near the middle of the intervening lull at 11h. 50m. p.m., the commencement of the large waves. The other two curves show only the last group, containing the maximum.

We have therefore on the horizontal force curve oscillations responding to the three initial shocks of the first and second earth tremors, and of the large waves. To these may be added the maximum oscillation at midnight, as probably responding to a sudden increment of the large waves.

The bifilar suspension, being a torsion balance against the horizontal force, is naturally more sensitive to sudden vertical movements of its pillar than to horizontal or slower vertical displacements.

WALTER SIDGREAVES, S.J.

Stonyhurst College Observatory, January 11.

As given by the Milne-principle seismograph here, the commencement of the phases of this quake were as follows:—Preliminary: both N. and W. boom, 11.34 p.m. Second: N. boom. 11.40; W. boom, 11.39·5 Principal: N. boom, 11.52·9; W. boom, 11.52·8.

The actual maxima were:—N. boom, 110·8 mm. at 11.58·7; W. boom, 131·0 mm. at 11.55, and 127·6 mm. at 11.58·3.

There were 30 after-shocks on the N. boom, lasting until 5.11 a.m., and 37 on the W. boom, lasting until 5.26.

F. EDWARD NORRIS.

Woodbridge Hill, Guildford, January 17.

The Markings f Mars.

MAY I mention on behalf of my relative, Mr. J. H. Worthington, to whose previous letter M. Antoniadi has replied in NATURE of January 5, that he is at present away on an eclipse expedition to the Pacific Ocean, and out of reach of correspondence?

A. M. WORTHINGTON.

1 The Paragon, Blackheath, S.E., January 17.

Fireball of January 9.

THE Rev. W. F. A. Ellison, of Fethard Rectory, near Waterford, saw a splendid meteor on January 9 at 7h. 35m. G.M.T. The apparent path was near Aries and Cetus from $25° + 3°$ to $27° - 13°$. Motion very slow, the whole duration being at least seven seconds.

The flight was directed from the radiant of the January Quadrantids, and it is possible that the fireball formed one of the larger fragments of that stream. But this is uncertain, and another observation is desirable to discover the true radiant. From Cornwall the meteor must have been a very fine object, and must have attracted the notice of many persons, though I have seen no published description of it.

W. F. DENNING.

THE ADMISSION OF WOMEN TO THE PARIS ACADEMY OF SCIENCES.

IN our last week's issue we gave an account of the action taken at the quarterly plenary meeting of the five academies of the Institute of France on January 5, in relation to the proposal of the Academy of Sciences to elect Madame Curie to the vacancy on the physical section of that body caused by the death of Monsieur Gernez.

A Paris correspondent has sent us a copy of the *Temps* containing a remarkable letter from M. Darboux, the permanent secretary of the Academy of Sciences, giving the reasons and motives of the academy for their decision. We have not space for the whole letter, which is admirable from start to finish, but M. Darboux insists upon a point missed in all the preceding polemic, which should have an important bearing upon the general question raised by it.

After referring to the magnificent work done by Madame Curie, and the honours which have been showered upon her, he points out that her proposed election as a working member of a busy academy is a matter of great importance, not so much to Madame Curie as to the academy itself.

"Tant de titres, tant de résultats mémorables obtenus dans un si court espace de temps donneraient certes à Mme. Curie le droit de réclamer comme une récompense méritée le siège occupé naguère par son mari. Mais un siège à notre Académie est plus et mieux qu'une récompense. S'il donne une satisfaction légitime et quelques droits, il impose aussi des

devoirs étendus. Pour examiner à ce point de vue la candidature de Mme. Curie, il est nécessaire que nous rappelions rapidement ici, pour le grand public qui l'ignore quelque peu, le rôle et le fonctionnement de l'Académie des sciences.

"Des cinq Académies qui composent l'Institut de France, elle est peut-être celle qui a la tâche la plus active et la plus lourde. Certes, comme la nôtre, les autres Académies ont des prix à distribuer, moins nombreux et moins variés peut-être; mais le soin de juger des concours et de distribuer des récompenses est bien loin de former notre principale occupation. Dans ses séances hebdomadaires du lundi, l'Académie écoute avec intérêt les communications, souvent nombreuses, de ses propres membres; mais elle reçoit en outre une foule de travaux, venus de Paris, de la province, de nos colonies, de l'étranger. Il n'est pas rare qu'une de nos séances recueille une centaine de communications ayant les origines les plus diverses. Les comptes rendus de nos séances paraissent le samedi de chaque semaine, cinq jours seulement après la séance; ils contiennent presque toujours de 50 à 100 pages in-4°, où se trouvent exposées les recherches les plus neuves, les plus intéressantes. On peut affirmer, sans crainte d'être démenti, que cette publication si rapide, si soignée, constitue le moyen d'action le plus puissant dont dispose aujourd'hui une société savante. J'ajoute que depuis trois ans, notre confrère le prince Roland Bonaparte a confié à l'Académie des sommes importantes, destinées à provoquer et à subventionner les travaux scientifiques les plus méritants.

"Pour accomplir cette tâche féconde, pour distribuer tous ces prix, toutes ces subventions, pour apprécier si rapidement la valeur des communications qui lui parviennent, l'Académie a évidemment besoin de faire appel à toutes les compétences. Où trouvera-t-elle un savant plus autorisé que Mme. Curie pour lui donner un avis sur ces travaux relatifs à la radioactivité, dont le nombre grandit si rapidement?

"D'autre part, ces chercheurs qui peuplent le laboratoire si prospère de Mme. Curie, qui travaillent sous sa direction, devront-ils se résigner à voir leurs efforts et leurs travaux méconnus ou négligés? N'y a-t-il pas un intérêt évident à ce que le chef qui inspire leurs travaux soit admis, comme ses autres collègues de la Sorbonne à les présenter, à les défendre dans les commissions de prix, à les proposer pour des subventions; en un mot, à remplir dans toute son étendue la fonction d'un membre titulaire de l'Académie des sciences?"

* * * * *

"Nous nous contenterons de remarquer, en terminant, que, s'il arrive souvent à notre pays de marcher à l'avant-garde des nations, dans le cas actuel c'est l'étranger qui nous aura donné l'exemple. Ne parlons pas, si l'on veut, des distinctions qu'a reçues de ce côté Mme. Curie, bien qu'elle ait été nommée *membre actif* de quelques-unes des académies que nous avons énumérées plus haut. Mais nous sommes allé dernièrement à Rome, pour y assister aux séances de l'Association des académies, et nous y avons vu la comtesse Ersilia Lovatelli siéger, en qualité de doyenne de la section d'archéologie, à l'académie royale des Lincei, qui joue en Italie le rôle de notre Institut. De même, lorsque nous assistions en 1900 aux fêtes du second centenaire de l'académie des sciences de Berlin, une dame encore, Mme. Elise Wendel, assistait à toutes les cérémonies au titre de membre honoraire de l'académie. Nous pourrions ajouter d'autres exemples; ceux-là suffiront à prouver qu'à l'étranger, on n'éprouve pas les scrupules qui font hésiter quelques-uns de nos confrères."

THE SOLAR PHYSICS OBSERVATORY.

We have received the following Memorial and accompanying signatures and documents from the hon. sec. of the British Science Guild, with a request that we should print it, together with the statement that the Memorial was handed to Mr. Asquith's private secretary by Sir David Gill, K.C.B., F.R.S., president of the Royal Astronomical Society, and vice-president of the British Science Guild, and Sir A. Pedler, C.I.E., F.R.S., hon. sec., and that the Prime Minister was pleased at once to grant the prayer of the memorialists:—

MEMORIAL
TO
The Right Hon. the Prime Minister.

The Memorial of the undersigned Fellows of the Royal Society and other bodies interested in the welfare of British Science to the Right Honourable H. H. Asquith, Prime Minister, and First Lord of the Treasury.

Sheweth

That in 1875 the Royal Commission on Scientific Instruction and the Advancement of Science strongly recommended the establishment by the State of an Observatory for Solar Physics.

That in 1879 this recommendation was acted upon by the Government.

That the accompanying letters from the Directors of the Chief Observatories and Meteorological Institutes in Europe and the United States show (1) that the work thus undertaken was of especial importance to the British Empire with its territory distributed all over the globe; (2) that the results already obtained are of high value, and promise eventually to lead to the better forecasting of droughts; (3) that the international character of the work makes it important that it should be carried on in close connection with a Government Department; (4) that a high-level site and free horizon are now essential.

That when a change of site of the Observatory became necessary, the Solar Physics Committee, a Consultative Committee appointed by the Government to advise them on such matters, selected a high-level site at Fosterdown on land purchased some years ago by the War Office, but no longer required by them. The Committee reported that this site fulfils the requirements of modern astronomical research.

And whereas, while we understand that the Solar Physics Committee have not withdrawn their recommendation, the site in question is now advertised for sale on December 13.

We, your Memorialists, therefore pray that the proposed sale of the selected site may be delayed until full inquiry has been made, and until a decision has been arrived at with full knowledge of the questions involved.

And your Memorialists will ever pray.

Lansdowne, Avebury, Rayleigh, Joseph D. Hooker, James Dewar, Iveagh, Lochee, R. B. Clifton, William Ramsay, J. A. Fleming, Fred T. Trouton, Arthur R. Cushny, F. W. Oliver, J. Norman Collie, L. N. G. Filon, E. C. C. Baly, Henry Miers, Augustus Waller, William White, Silvanus Thompson, A. Mostyn Field, J. Wolfe Barry, William Crookes, J. H. Poynting, William Turner, R. A. Sampson, Raphael Meldola, David Bruce, Lauder Brunton, Arthur H. Church, Charles Chree, Dugald Clerk, Wyndham Dunstan, E. H. Griffiths, J. Herschell, W. M. Hicks, Fletcher Moulton, H. E. Roscoe, E. T. Thorpe, William Tilden, E. Ray Lankester, W. H. Dines, G. T. Beilby, C. A. Parsons, John Murray, Arthur A. Rambaut, Blyth, Chichester, John Cockburn, Alfred Keogh, J. Herbert Warren, George Burt, George Reid, Baldwin Latham, W. F. Caborne, J. C. Bayard, E. Gold, H. N. Dickson, M. W. C. Hepworth, R. C. K. Lempfert, C. Theodore Williams, P. H. Cowell, Percy Davis, H. H. Walmesley, T. C. Hudson, William Fraser Doak, John A. Sprigge, Harold B. Dixon, James Crichton Browne, H. G. Lyons, George Hartley Bryan, E. Taylor Jones, John Perry, James Stirling, Hugh L. Callendar, P. A. MacMahon.

The letters appended to the memorial are from the following:—

(1) *Directors of Astronomical and Astrophysical Observatories.*

Sir David Gill, President of the Royal Astronomical Society, formerly Director of the Royal Observatory, Cape of Good Hope

Prof. Pickering, Director of the Harvard College Observatory, U.S.A.

Dr. Hale, Director of the Mount Wilson Observatory, U.S.A.

Dr. Backlund, Director of the Poulkovo Observatory, Russia.

Prof. Riccò, Director of the Royal Observatory of Catania and Etna, Italy.

Dr. Deslandres, Director of the Astrophysical Observatory, Meudon, Paris.

Prof. Max Wolf, Director of the Astrophysical Observatory, Heidelberg.

(2) *Directors of Meteorological and Physical Institutes.*

Dr. von Hann, formerly Director of the Meteorological Institute, Vienna.

Prof. Kayser, Director of the Physical Institute, Bonn.

Dr. Steen, Vice-President of the Meteorological Institute, Kristiania.

(*Copy.*)

34 De Vere Gardens,
Kensington,
London, W.,
November 14, 1910.

DEAR LOCKYER,—

At your request I have visited, in company with your son, the site at Caterham to which you propose that the instruments at present mounted at South Kensington should be transferred. As the result of this inspection I venture to express my earnest desire that advantage should be taken of this most favourable site.

It would be hard, in my opinion, to find a better one in England. It is about 800 feet above sea-level, and overlooks a wide and splendidly clear horizon. It is within half an hour's walk of a railway station, and thence within less than an hour's journey, by frequent trains, to Charing Cross. The site is completely protected from the glare of light from any neighbouring town, so that one great desideratum for stellar work, that of a dark sky, is secured. The contour of the neighbouring ground is such as to secure immunity from the danger of houses being built in the immediate neighbourhood. The surrounding slopes are covered by trees which protect the surface of the soil from the sun's heat, so that it is probable that the disturbance to good seeing, caused by convection currents, will probably be reduced to a minimum.

It is, I believe, a general experience in this country that the best definition for solar observation occurs in the early morning hours, and sometimes again in the late afternoon. This seems to be due to the comparative freedom from convection currents of air, in the morning before the soil is heated up, and in the evening when a condition of equilibrium is established, and it seems, so far as can be judged from inspection of the site, that the surroundings of the Caterham site are specially favourable from this point of view. There are other circumstances which point to the selection of the Caterham site:—

(1) The ground belongs to the Crown.

(2) It is distant from any roads, and therefore free from tremor.

(3) The atmosphere is free from smoke, and the site above low-lying mist.

(4) It is the site of a now disused Ordnance store for ammunition, provided with splendidly built and perfectly dry casemates, which would form rooms of nearly uniform temperature that could be used for spectroscopic research, dark-rooms, &c., and there are other existing buildings which could be utilised for observatory purposes, such as stores and working rooms.

(5) The casemates themselves would afford, on their upper surface, splendid foundations for instruments.

(6) There is excellent local material on the ground suitable for concrete.

Thus the expense of establishing the observatory would be greatly reduced by these pre-existing works and by the natural facilities afforded by the site.

I have no doubt that the Meteorological Office can furnish statistics as to the average amount of cloud and sunshine, and little doubt that in this respect the conditions are as favourable as any for the pursuit of Astrophysical and Solar research.

That it is the duty of our country to provide for the continuity of the work so well begun by you I think no man of science will dispute, and it would indeed be shame to us, in the face of what other nations are doing, if we are left behind in the race which was so well begun in this country by yourself, and which has been continued by you so successfully under conditions so unfavourable. In any change of site I venture to think it will be a great mistake if the best possible site is not chosen, and I do not think it is likely that a better site than that at Caterham will be found in these islands.

Yours sincerely,
(*Signed*) DAVID GILL.

(*Copy.*)

Harvard College Observatory,
Cambridge, Mass.,
November 4, 1910.

MY DEAR SIR NORMAN,—

Your letter of October 20 is received. I hear with great regret of the unfavourable changes which are proposed in the Solar Physics Observatory. The list of your publications and of the important results contained in them is very impressive. It seems to me that your persevering and long-continued work in astronomy, extending over nearly half a century, ought to be continued by you under favourable conditions, if possible. Moreover, it is obvious that the efficiency of the powerful instruments which you have collected will depend very largely on the location in which they are remounted. Every year this matter is receiving more attention among astronomers. The work of many instruments could easily be doubled by mounting them in more favourable locations. The most serious effect we have felt from the encroachment of the city of Boston has been the illumination of the sky by the electric light.

Yours very truly,
(*Signed*) EDWARD C. PICKERING.

The Athenæum,
November 7, 1910.

MY DEAR SIR NORMAN,—

You ask me for an opinion as to the value of the work done under your direction at South Kensington, and the importance of providing for its continuance under more favourable conditions. As you know, I have not always agreed with you as to methods of observation and the interpretation of results. But this has not prevented me from admiring your fertility and ingenuity in the formulation of hypotheses, and the activity of yourself and your assistants in testing them. The large amount of work done by your staff in the midst of London should encourage those who see in the establishment of large modern observatories a menace to smaller institutions.

The importance of providing for the Solar Physics Observatory in the future seems to me so obvious that I can hardly believe the Government will fail to do so. After permanence has been assured, the most vital point, in my opinion, is to discover a sufficiently able director to take up the work when you retire. Then come the exceedingly important questions of site and equipment. I cannot compare the merits of the two sites you mention, as I have not seen the one you prefer and you do not name the other. Other things being equal, high altitude, minimum cloudiness, a clear and transparent sky, absence of glare from street lights, and freedom from vibration are, of course, very important.

But the prime consideration is good definition of solar and stellar images, without which the most refined work cannot be done, in certain classes of observations.

You refer to the need of a clear eastern horizon. On Mount Wilson (altitude, 6000 feet) it is essential that the

sky should be clear within ten or fifteen degrees of the eastern and western horizons, as the best definition of the solar image is usually obtained from one to three hours after sunrise and before sunset. At the Yerkes Observatory (1200 feet) solar observations are not begun until about 9 a.m. I have seen the definition as perfect there at noon as at any hour of the day, though I believe the average early morning definition would be better than the average noon definition. I do not know what the corresponding conditions are in England, but at Catania, and on Mount Etna and Mount Hamilton, the early hours are the best. In general, I believe the superiority of the early morning and late afternoon hours to be most marked on mountain tops, and in hot countries where there is much convection.

Trusting that the Government will make ample provision for the observatory, and establish it on a favourable site,

I am,
Yours very truly,
(*Signed*) GEORGE E. HALE.

Sir Norman Lockyer, K.C.B., &c.,
Director of the Solar Physics Observatory,
South Kensington.

(*Copy.*)

Observatoire Central Nicolas,
Poulkovo Gouvernment de St. Petersbourg,
Cabinet du Directeur,
November 1, 1910.

DEAR SIR NORMAN,—

I am deeply touched by the sad news of the danger that threatens the continuity of your fruitful activity which is recognised by the scientific world as having most successfully contributed to the development of our knowledge of Solar Physics. Since the first foundation of chemical analysis of the sun was laid by Kirchhoff and Bunsen, your name has been intimately associated with the progress of Solar Physics. The memorable year 1868, when you and Janssen, independently of each other, taught us how to conduct solar observations, is the beginning of a new epoch in which the solar researches revealed the most wonderful facts.

The connection between periodical activities on the surface of the sun and terrestrial phenomena demands to be investigated so as to give a trustworthy base for a great part of the Meteorology. This investigation requires great endurance, experience, and self-sacrifice, as the results can be obtained only by means of continued cooperations. Your organisation of the Solar Commission to work on that line is just the way to realise the solution of this important question, and consequently it would be a great disappointment if a discontinuance should take place.

I am convinced that the continuation of the institution erected by you is an intense desideratum recognised by every astronomer. If your observatory is to be removed it should certainly be to a better place than it actually occupies. I am therefore not able to comprehend why an unfavourable position should be assigned to it. It seems to me that you have so legitimate a claim on every kind of support in your endeavour to promote science that such a case would be absurd, and that everyone who recognised the importance of the knowledge of Solar Physics and the connection between terrestrial phenomena and the sun would deeply deplore the interruption of your successful activity.

Yours very sincerely,
(*Signed*) O. BACKLUND.

(*Copy.*)

R. Osservatorio di Catania ed Etneo,
Direzione,
Catania, le 31 octobre, 1910.

MONSIEUR LE DIRECTEUR,—

J'ai appris avec une vraie peine que vous vous trouvez en des grandes difficultés à cause des changements qui vont avoir lieu pour le site de votre très important Observatoire.

Il serait vraiment déplorable que vous n'ayez pas la possibilité de continuer et même de porter encore plus en avant votre grande et splendide série de travaux qui est commencé avec l'application du spectroscope à l'étude des taches solaires et puis des protubérances, ce qui vous a conduit à la découverte de la méthode d'en faire l'observation en dehors des éclipses, si féconde en tous temps.

Et ensuite viennent vos importantes études sur l'enveloppe solaire, que vous avez appelé *chromosphère*, sur la substance alors inconnue, que vous avez nommée *helium*, et puis les observatoires des éclipses solaires, où vous et Respighi les premiers, vous avez fait usage du prisme objectif, qui a donné toujours des résultats de la plus grande importance pour la physique et la Chémie du Soleil.

Non content de tout cela vous avez porté vos recherches sur les spectres des métaux et autres substances, pour faire des comparaisons avec les phénomènes solaires.

Et ce qui est bien admirable, tout cela a été fait par vous seul et avec vos moyens privés.

Ensuite par votre inépuisable initiative et sur votre proposition, l'Angleterre a fondé des stations pour l'observation photographique du soleil en des climats plus favorables, dont le succès a été tout à fait complet pour donner la statistique de l'activité solaire. Et on vous doit aussi l'établissement à South Kensington des nouvelles et délicates observations spectrohéliographiques.

Et passant à l'application pratique des études solaires, vous avez entrepris de vastes recherches sur les relations entre les phénomènes solaires et les phénomènes météorologues terrestres d'où suivit la création de la *Commission internationale* pour l'étude de ces relations, dont vous avez été élu Président.

Et votre indomptable activité s'est portée aussi sur les météorites, sur les comètes, sur les étoiles, et ainsi vous avez été conduit à fonder une nouvelle classification et une nouvelle hypothèse sur l'origine des astres, très appréciée par les savants.

Et enfin il ne faut pas oublier vos intéressants recherches archéologiques qui ont des relations très importantes avec l'astronomie ancienne et la chronologie.

Tout cela est apparu en plus que 200 publications, et il paraît vraiment impossible que cette grande production scientifique soit l'œuvre d'un homme seulement, et même en tenant compte de la collaboration de vos vaillants élèves et aides. Et il faut ajouter que tout cela a été fait avec des moyens très limités, avec des difficultés de toutes sortes, en une installation excessivement modeste; je n'ai pas oublié ma surprise, lorsque j'ai eu le bonheur de visiter votre observatoire à South Kensington, qui a une si grande renommée dans la science, de trouver un ensemble des cabanes en bois et canevas, si modeste, et je dirai même si pauvre, pour l'Angleterre qui est si riche!

Mais j'espère que le changement que vous craignez vous donnera au contraire un établissement digne de vous, de votre grand Pays, de la science que vous cultivez d'après 40 ans avec tant d'ardeur et de succès, qui a suscité l'admiration de tout le monde scientifique; et je suis sûr que le nouvel observatoire sera encore mieux situé pour répondre aux besoins de vos études et au progrès de l'Astronomie physique moderne; c'est-à-dire qu'il sera construit sur une place élevée, avec une atmosphère plus pure et moins éclairée que celle de Londres.

Voilà mes vœux les plus sincères et les plus froides que je vous envoie avec mes salutations les plus distinguées et les plus cordiales.

Votre ancient admirateur,
(*Signed*) A. RICCO.

Catane le 20 novembre, 1910.

MONSIEUR LE PRÉSIDENT,—

En vous écrivant à propos de la translation de votre Observatoire j'ai manqué de remarquer une condition nécessaire et qui certainement ne vous est pas échappée. C'est la condition que votre nouvel observatoire domine bien l'horizon Est, à fin de pouvoir commencer les observations solaires le plus tôt que possible après le lever du soleil, de manière qu' elles puissent se rattacher à celles qui se font aux stations plus orientales que Londres, et

pour avoir devant vous toute la journée pour réussir à les accomplir lorsque le ciel n'est pas entièrement serein.

Je me permette d'attirer votre attention sur ce point important, parce que nous éprouvons à Catane l'inconvénient de ne pas avoir l'horizon Est tout à fait libre.

Agréez, M. le Directeur, mes sentiments de la plus grande considération.

Votre très dévoué,
A. RICCÒ.

(*Copy.*)

Observatoire d'Astronomie Physique de Paris,
Sis Parc de Meudon,
Seine-et-Oise,
Meudon, le 30 octobre, 1910.

CHER MONSIEUR LOCKYER,—

J'apprends que votre observatoire de South Kensington doit être transféré en dehors de la ville, en pleine campagne, c'est-à-dire dans un lieu plus favorable aux études solaires. Je vous adresse à ce sujet mes vives félicitations, et je souhaite que le gouvernement anglais vous donne largement les subsides nécessaires, et vous permette de créer une organisation nouvelle qui soit bien en rapport avec l'importance toujours croissante des recherches solaires.

Votre observatoire actuel de South Kensington est bien mal pourvu; la plupart des instruments sont anciens, et tous les bâtiments sont en bois léger, cependant vous y avez fait de grandes choses, aussi bien sur les étoiles que sur le Soleil. La même remarque s'applique à vos premières observations de Wimbledon, et à votre grande découverte de 1868, qui nous a dévoilé l'atmosphère du Soleil, et a été le point de départ de toutes les recherches actuelles, si étendues, sur le Soleil. Vous opériez avec de petits instruments que dédaigneraient nos étudiants d'aujourd'hui.

Dans ces premières recherches qui ont fixé les méthodes, la valeur de l'homme pouvait suppléer à la faiblesse des appareils. Mais, pour appliquer les méthodes avec tout le développement qu'elles comportent, des installations largement conçues, des instruments de grande puissance sont nécessaires. On l'a bien compris en Amérique, où les observatoires solaires sont magnifiquement organisés et aussi quelque peu en France où le Parlement nous a accordé récemment des crédits extraordinaires. L'Allemagne, La Russie, l'Italie et même l'Espagne ont suivi le mouvement. Vous seuls, les Anglais, vous êtes actuellement en arrière, en retard, au moins en ce qui concerne les installations, car votre observatoire, en fait, a été le premier en date et l'initiateur des méthodes.

Heureusement, l'utilité et la nécessité d'une étude complète du Soleil apparaissent à tous de plus en plus évidentes, et vous avez contribué plus que personne à créer cet état des esprits par vos belles recherches récentes qui dévoilent une relation simple entre les protubérances solaires et le régime des vents et de la pluie à la surface de la terre. Certes tous les hommes, même les plus bornés, comprennent l'influence maîtresse du Soleil sur la terre, mais le lieu qui les nuit est beaucoup plus étroit qu'on ne le suppose au premier abord. Toutes les perturbations solaires ont leur répercussion sur la terre et son atmosphère, et si on veut démêler les causes des variations si complexes de notre atmosphère, il faut d'abord suivre avec le plus grand soin les variations du Soleil.

Ces dernières raisons, et leur côté utilitaire, ont frappé tout particulièrement les membres du Parlement et du Sénat français qui m'ont accordé des crédits pour le Soleil. Je leur ai parlé aussi de vos recherches sur la comparaison avec les étoiles, et sur la place du Soleil dans la nature, recherches qui ont un intérêt surtout philosophique.

Tels sont les renseignements que je puis vous fournir sur les conditions faites en France à l'astronomie physique, et solaire. Je puis les compléter d'autres détails, si vous le jugez utile.

Je vous souhaite le meilleur succès dans l'œuvre que vous poursuivez pour le plus grand bien de la science, et je vous prie d'agréer l'expression de mes sentiments respectueuses et dévoués.

(*Signed*) H. DESLANDRES.

(*Translation.*)

The South Kensington Solar Physics Observatory under the direction of Sir Norman Lockyer.

THE discoveries and work of the South Kensington Solar Observatory under the direction of Lockyer have been so unusually fruitful and numerous that it is quite impossible to mention here even all of the most important. Some of them are arbitrarily selected.

The discovery which brought Sir Norman Lockyer the first great reputation was certainly that which enabled us to observe the prominences of the sun even without an eclipse if his spectroscopic method were used. Another discovery of undying renown was the finding of helium in the sun, which twenty-seven years later Sir William Ramsay proved to exist in the nitrogen of the earth's atmosphere.

That the absorption in sun-spots is increased was discovered by Lockyer, and thereby the path was laid for the only possible comprehension of the constitution of the solar globe.

The exact proof of a great number of terrestrial elements existing in the sun was of fundamental importance.

Doppler's principle was first applied by Lockyer to the processes of movement in the sun's atmosphere. By this means it became possible to recognise and investigate the ascending and descending currents in the sun's atmosphere. It was thus shown that in the sun similar meteorological movements occur to those on our earth, but they are much more powerful.

The use of the objective-prism without slit in solar eclipses by Lockyer first rendered possible the exact investigation of the constitution of the chromosphere and solar corona.

The investigations of the variability of the spectra of the elements in the sun and in sun-spots with the spot-period had great influence upon the scientific development of the last decades. They went hand in hand with the development of Lockyer's bold hypotheses of the dissociation of the elements. The great discovery that different parts of the electric arc give different spectra for one and the same element would alone have been of the greatest influence.

Although the hypotheses have changed with time, the substance of them has been accepted directly through the most recent advances of physics and the cognisance of electrons, and there is no doubt that they have been directly of invaluable importance to the progress of science through the objections to which they have given rise.

Quite as fruitful, contested and defended, are the views put forth by Lockyer and South Kensington respecting the formation of the universe from meteoric dust and gases. The detailed studies respecting the emission lines of metals under the application of the highest electric energy could hardly have been made without them, and the numerous excellent studies in detail of the different kinds of suns found in the firmament in a different stage of development, which we owe in recent years to South Kensington, have all sprung from this leading point of view.

Even if those investigators are right who vehemently contest many points of the hypothetical construction of the development of the stars, a valuable core will still remain. The full utility of the enormous materials collected respecting the spectra of the elements, of the stars, and the sun will remain of lasting value.

The numerous ingenious improvements and inventions in spectroscopic methods, spectroscopes, telescopes, and apparatus which have emanated from South Kensington are of the greatest utility.

The statistical investigations of the influence of the sun upon terrestrial weather conditions proceeded hand in hand with these astrophysical labours. After South Kensington had shown that the higher radiation energy of the sun occurred at the time of sun-spot maximum, and not at the time of the minimum, the problem was attacked in many different ways in order to show the influence of the solar period upon terrestrial magnetism, pressure, and temperature conditions of the earth's atmosphere, and amount of rainfall. It was seen that success could only be obtained if the conditions over the earth as a whole were taken into account. The establishment of the Solar Commission of the International Meteorological Committee

and the collection of observations from all stations round the earth was the next step, and South Kensington became the headquarters for this collective work, the results of which have already began to bear the most interesting fruits.

Although this short *résumé* has only touched upon the most striking pieces of work, it must, however, show beyond doubt that the institution directed by Lockyer at South Kensington has played a universally stimulating and leading part in the scientific world.

Solar physics, and also astrophysics, are in England closely connected with South Kensington Observatory—as in France with Meudon, in America with Mount Wilson, and in Germany with Potsdam. It forms for the scientific reputation of England an essential part, and if during recent years it has not been able to keep pace in many things with the largest institutions of other countries, it was owing to the abnormally unfavourable position in the smoke of the metropolis London and the relatively small funds which have inconceivably been placed at its disposal.

(*Signed*) DR. MAX WOLF.

Heidelberg, October, 1910.

(*Translation.*)

Vienna,
November 1, 1910.

MY DEAR SIR,—

I have learned with the greatest regret that the activity of the Solar Physics Observatory will be interrupted, and that, generally speaking, by the removal of the observatory to an unsuitable place, with unfavourable atmospheric conditions, there is danger of the continuance of the work being hampered, the success of which, so far, has been acknowledged in the widest circles.

Just at the present time, when all the larger countries are about to take up the solar investigation inaugurated in England through them specially, or are thinking of doing so, when, especially in America, large sums are expended upon it, it seems inconceivable that injury should be contemplated to an observatory devoted to this investigation, which can look back upon thirty-eight years of such successful work, notwithstanding the small funds at its disposal. Should England wish to put itself even partially out of action in the cooperation in such a promising field of inquiry? An Empire which extends over the whole earth should at least support a work that has done so much that is surprising and practically important in the discovery of intimate relations between atmospheric conditions of the remotest parts of the earth.

Your very numerous works and publications in the domain of stellar and solar physics, which have long since received the appreciation of distinguished astronomers, have also placed investigators of terrestrial magnetism and meteorologists under the greatest obligation. They have shown us new methods and new aims. Especially is this so in the indication of a short period in the solar and meteorological variations on the earth; the extension of the Bombay-Cordoba "see-saw" of the variations of atmospheric pressure over the whole earth; the variations in temperature and rainfall with solar changes in the neighbourhood of the Indian Ocean (pulses in Indian rainfall at spot maximum and minimum); solar activity, 1833 to 1900, and the discovery of a period of about thirty-five years in the same, with which magnetic and meteorological periods (Brückner's cycle) correspond; the relations between solar protuberances and the manifestations of terrestrial magnetism, &c.

Meteorologists and investigators of terrestrial magnetism must therefore express the most earnest desire that the activity of the Solar Physics Observatory heretofore may not suffer retrenchment in any direction, but, on the other hand, that it may be extended.

With great respect, &c.,
(*Signed*) J. HANN.

Bonn,
Humboldtstrasse 2,
October 25, 1910.

DEAR SIR NORMAN,—

I am sure that to everyone who knows something of spectroscopy and astrophysics the name of yourself and of the South Kensington Observatory are most familiar. These names are so intimately connected with the progress we have made in the last forty years, that even the beginner must know them. I think it is impossible to overestimate the services you have rendered to astrophysics and astronomy.

When I first had the opportunity of seeing your observatory—it is a long time ago, I think twenty years—I admired that you have been able to do all this work in such a place and under such poor conditions. Some years ago, when I first heard that the place of your observatory was needed for other purposes and that you should get a new observatory, I was very glad, because I was sure that the English Government would be happy of the opportunity to give you the best available place and good buildings, and so promote the most needed continuation of your work in a better site. I was sure that the English Government is aware of the high importance of astrophysics for human knowledge and culture, and full of gratitude to you who has spent a successful life to the promotion of this science under such difficult conditions.

You can imagine how astonished I am to hear that your Government will give you a site quite unfit for the purposes of astrophysics. I can only suppose that such a plan has been taken into consideration without full knowledge of the importance and the needs of astrophysical work. So I hope surely that the Government, when better instructed, will change its mind and give you the site you need.

In the last meeting of the International Union for Solar Research, held this year in California, the Union resolved to send messages to the Governments of Japan and Australia asking the erection of astrophysical observatories. I am sure that every member of the Union would second your claim for a well-situated new observatory. I hope the English Government will hear the wish of all the civilised nations not to interrupt, but to promote, the work of yourself and of your observatory.

Please make any use you like of this letter.

I am, dear Sir Norman,
Yours most truly,
(*Signed*) H. KAYSER.
Director of the Physical Institute of the University.

Det Norske Meteorologiske Institut,
Kristiania,
October 29, 1910.

DEAR SIR,—

I am much obliged to you for the good opinion shown by the value which you attach to a declaration from me concerning the work of the Solar Physics Observatory.

After my return from Cambridge and London in 1904 I wrote an article in the Norwegian newspaper *Aftenposten* expressing my admiration of your celebrated observatory, and my opinion of the importance of its splendid work for the future of meteorology. I venture to give here subjoined a translation of that part of the article which concerns the subject in hand.

"The man who has taken the initiative in the first organisation of the new lines in meteorology is, as already mentioned, Sir Norman Lockyer, one of England's most eminent men of science. He was born in 1836, and from his earliest youth has worked at the study of what takes place in the sun. In 1868 he discovered in the sun's chromosphere a then unknown substance, helium, which is now thought to be a gaseous modification of the now famous radium. Lockyer has been an observer of almost all the total eclipses of the sun during the last forty years, and in 1868 he found—simultaneously with, but independently of, the French astronomer, Janssen—a method of observing the sun's prominences at any time by the aid of the spectroscope—a very great step in advance, as formerly this phenomenon could only be observed during the rare, brief moments of a total eclipse.

"It was mainly due to Lockyer's perseverance that as early as the 'seventies of last century an observatory, exclusively for solar observation, was erected in India, whose tropical position is especially favourable to that kind of observations. At the same time a small physical-chemical laboratory in South Kensington was given up to him, and turned into the now so celebrated Solar Physics Observatory, which, under Sir Norman's management, has gradually risen to be a first-class scientific institution.

"The observatory, however, is not very easy to find in the labyrinth of the world-city. It is well concealed behind the great South Kensington Museum, in a back-yard of the museum, with access to it through an insignificant-looking side entrance in the Exhibition Road. The observatory buildings themselves, five or six in number, also present a very plain appearance, giving the impression, when seen from a distance, of being part of a travelling menagerie or circus.

"But on passing within these wooden walls and tent-doors one is deeply impressed by the wonderful instruments and apparatus with which Sir Norman Lockyer and his son, Dr. William Lockyer, aided by a staff of assistants, draw forth the sun's secrets by astronomical, spectroscopic, and photographic means. The instrumental equipment of the observatory is probably unique of its kind, and in the meteorology of the future the Lockyers' Solar Physics Observatory in South Kensington will rank among the first to be counted with."

Since that time I have followed the publications from the observatory with much interest, observing the great progress in all branches of solar inquiry and its relations to meteorological and other terrestrial phenomena. It is my sincere hope that the new position of your observatory may be such that you, dear Sir, and your admirable scientific staff, may carry on your work on the same lines as before, untroubled by difficulties arising from local disturbances.

I am, dear Sir,
Sincerely yours,
AKSEL S. STEEN.

Vice-Director of the Norwegian Meteorological Institute.,
President of the Norwegian Geographical Society.

SOLWAY BIRDS.[1]

COUNTY histories of birds have followed each other in such rapid succession during the past few years that the majority of those the geographical situation of which gives them special importance, have found historians. This the latest addition deals with the avifauna of Dumfriesshire and the Solway area, which is to say that the neighbouring counties of Kirkcudbright and Wigton are included in the author's purview. Mr. Gladstone's survey, therefore, covers the whole of the very interesting south-west corner of Scotland along the shores of which the Solway ebbs and flows.

The region is indeed very fortunate in its historian. He has supplied all that the ornithologist can wish to know concerning the occurrence of its birds. His book is also a meritorious production from the publishers' and bookbinders' point of view. It is light to hold and very attractive on account of its excellent paper, bold, clear type, and the beauty of its illustrations. Messrs. Witherby, the publishers, one of whom is a well-known ornithologist, now appear as the worthy rivals in London of the distinguished place which the house of Douglas in Edinburgh has so long held for the production of ornate books on natural history.

Mr. Gladstone has added interest to his work by placing on record the names, with a short biography, of each of the ornithologists of the county, of whom from about 1650 there appear to have been a goodly number. Among them occur such well-known or distinguished names as Captain Clark Kennedy, Robert Gray, Dr. Grierson, Sir William Jardine, William Laidlaw (Sir Walter Scott's amanuensis), the Rev. Hugh Macpherson, and Sir John Richardson, naturalist to the Franklin Arctic expedition, and the discoverer of Huxley.

Short eared Owl on the Nest, photographed by Mr. F. Barber-Starkey. From "The Birds of Dumfriesshire," by Hugh S. Gladstone.

The physical features of the county, which embraces an area of a little more than 686,000 acres of land surface and 21,000 of water and foreshore, are very varied. The northern part is mountainous, rising into hills more than 2000 feet, "intersected by glens and valleys"; the southern "breaks into three great 'dales,' named from the Nith, the Annan, and the Esk." The wide Solway firth is an area of special importance to the natural history of the district, for

[1] "The Birds of Dumfriesshire—a Contribution to the Fauna of the Solway Area." By Hugh S. Gladstone. Pp. xcix+482. (London: Witherby and Co., 1910.) Price 25s. net.

it provides vast feeding grounds for shore birds, although, in the absence of cliffs, rock-breeding species are scarce or absent. Dumfriesshire has been re-afforested to a wide extent since the earlier parts of the last century. Consequently suitable habitats have been provided for many species which would not otherwise be included in its register, while "hedge enclosures with rows, belts, or clumps of ornamental or 'wind-breaking' trees have greatly encouraged the increase of passerine birds." The firth opens its arms also to welcome home-coming immigrants and birds of passage. "There is no doubt," as Mr. Gladstone remarks, "that in comparatively recent geologic times the Irish Channel was a great tidal river, of which the Solway streams were its northernmost tributaries, and that this ancient river valley was the route by which the birds went and came in long by-past ages—a route which has left so strong an impression on posterity that the birds travel along what is now a broad sea-way."

The number of species recorded from Dumfries is of residents, 70; summer visitants, 31; winter visitants, 31; occasional visitors, 30; very rare or accidental visitors, 56; or, in all, 218. One reads with regret that eagles and harriers have ceased to nest; that martins, barn-owls, and swallows are scarcer; but, on the other hand, it is pleasant to know that pied flycatchers, tufted ducks, great spotted woodpeckers, jays, woodcock, and peregrine falcons have become more numerous. The author's biographies—all of them just what they should be—of the different species, abound with interesting observations. In speaking of the dipper, by the way, Mr. Gladstone records that there has been a nest in a certain stream for 123 years in succession. There are a score of heronries in the county, and the list of rookeries is a long one, the site of some of them dating back for more than 600 years. Notwithstanding that 36,000 rooks have been killed in the last three years, the stock shows few signs of decimation. Incursions of sand-grouse and of continental crossbills are recorded, the latter species nesting apparently only for a few seasons after such visitations.

We commend heartily "The Birds of Dumfriesshire" to all British ornithologists, and especially to those north of the Solway. The volume is provided with what is too often forgotten in faunistic books, an excellent map, and, with a good index, a *sine quâ non* of a book of reference, if it is to be fully useful. By the courtesy of the publishers we are able to exemplify its illustrations by a specimen of the twenty-four full-page pictures which adorn it.

NOTES.

On Monday next, January 23, an important development in Oceanographical Science will take place by the inauguration of the Oceanographical Institute in Paris, which has been founded and endowed by the Prince of Monaco. In Nature of April 14 and November 3, 1910, notices appeared of the opening of the Oceanographical Museum founded by the Prince at Monaco, and a description of the museum and its objects was given by Mr. J. Y. Buchanan. With the opening of the Institute next week, a further development will take place; for the Institute will now be composed of, first, the Institute at Paris; secondly, the Museum at Monaco. The Prince has described the Museum at Monaco as the workshop, and the Institute in Paris as the retail house. The Institute is French and international—French because its seat is in Paris, directed by a French administrative committee consisting of M. Emile Loubet, M. W. Darboux, M. Cailletet, Dr. P. Regnard, Mr. Georges Kohn, and Mr. Louis Mayer; international because the scientific and technical direction is in the hands of what is termed the "Comité de Perfectionnement," of which the president is the Prince of Monaco, and the vice-president Mr. J. Y. Buchanan, while the other British members are Sir John Murray, K.C.B., and Dr. W. S. Bruce. The committee also includes the names of many eminent French, German, Scandinavian, and other oceanographers. While the Museum is under the direction of Dr. Jules Richard, the Institute in Paris is under the administration of Dr. P. Regnard. Three professors are connected with the Institute—M. Joubin for biological oceanography, M. Berget for physical oceanography, and M. Portier for the physiology of marine creatures. After the opening of the Institute on January 23 the Comite de Perfectionnement will meet, and future arrangements for the development of the Institute will be duly considered.

Sir David Gill, K.C.B., F.R.S., has been elected a foreign member of the Swedish Royal Academy of Sciences, Stockholm.

A Reuter message from St. Petersburg announces that the Russian Academy of Sciences has conferred honorary membership on Prince Albert of Monaco, and has elected the following as corresponding members:—Mr. Bryce, British Ambassador to the United States; Prof. Lorentz, Leyden; Prof. Strasburger, Bonn; and Prof. Lewes, Albany.

At the meeting of the Paris Academy of Sciences on January 3, the incoming president, M. Armand Gautier, comparing the practice of the Academy with that of the Royal Society, mentioned the fact that during the half-hour preceding the formal opening of each meeting of the latter, the fellows meet in the ante-room for informal conversation, and he expressed the hope that a similar arrangement could be organised for the Academy. This would avoid the necessity for private conversations being carried on during the actual meeting.

It is reported from Sydney that the Science Congress—which, we suppose, is the Australasian Association for the Advancement of Science—has voted 1000*l.* for Dr. Mawson's Australian Antarctic expedition, which is starting in November for the purpose of exploring the regions between Cape Adare and the Kaiser Wilhelm II. Land. Three Australian citizens are each contributing 1000*l.* to the expedition, and other generous help has been promised.

The report referred to in a paragraph last week (p. 342), that the town of Prjevalsk in Turkestan was destroyed by waves of the Issil-Kul Lake during the Vyernyi earthquake of January 3–4, proves to have been incorrect. The towns along the northern shore of the lake, however, suffered severely, and fifty persons were killed. It will be noticed that the position of the epicentre as given in Dr. W. N. Shaw's letter (p. 335) is in the immediate neighbourhood of the lake.

According to a Press message from Winnipeg, information has reached there from Fort Churchill, on Hudson's Bay, that the schooner *Jeanie*, with fifteen geological surveyors on board, was wrecked on September 9, 1910, in a gale near Wagner inlet. After suffering great hardships the party reached Fort Churchill on December 1, and is now on its way to Winnipeg by dog train. The party left Ottawa last spring to investigate the flora and fauna in the Hudson's Bay district.

A Reuter message from Washington states that the members of the U.S. Geodetic Survey who have been examining Commander Peary's Arctic observations

declared, during the hearing of his request for retirement from the Navy, that the explorer went within sixteen to ten miles of the North Pole. It is also announced from Washington that the House Committee on Naval Affairs has reported favourably on the Bill retiring Commander Peary with the rank of Rear-Admiral "on account of his Polar attainment."

A REUTER message from Berlin states that, under the presidency of the Minister of Public Worship, a meeting was held there on January 11 to draw up a foundation scheme for the Emperor William Society for the Encouragement of Science. According to the resolutions adopted, membership will entail an entrance fee of 1000*l.* and a yearly subscription of 50*l.* The society will be governed by a general assembly, a senate, and an executive committee. The senate will consist of ten members elected by the society, but the power to appoint additional senators is reserved by the Emperor, as protector.

WE learn from the *Revue scientifique* that the French Budget for 1911 provides various grants to learned societies in France. Among these may be mentioned 1400 francs to the mathematical society; 1000 francs each to the societies of anthropology, zoology, biology, and botany, the prehistoric society, the Bordeaux society of sciences, and the Rennes society of sciences; 600 francs to each of the societies of meteorology, mineralogy, and the Nantes society of sciences. Grants of 500 francs are made to three societies, of 400 francs to three societies, and 240 francs to one society. A grant of 25,000 francs is included for the fund available to assist scientific research.

THE director of the Meteorological Office announces that the series of meetings commenced in 1905 for the informal discussion of important contributions to meteorological literature, particularly those by colonial and foreign meteorologists, will be continued this year. The meetings will be held on the following Mondays, at 5 p.m.:—January 23, February 6 and 20, March 6 and 20. At the opening meeting on Monday next, Prof. Grossmann will open a discussion on the relation between the temperatures of the North Atlantic Ocean, and of North-West and Central Europe. The subjects suggested for discussion at subsequent meetings are as follows:—Meteorologische Optik, J. M. Pernter; Cloud Report, Part ii., H. H. Hildebrandsson; scientific results of the *Scotia*, 1902–4, R. C. Mossman; Einfluss des Windes auf die Fahrt von Dämpfern, P. Heidke; on the influence of the earth's rotation on ocean currents, W. Ekman; on the influence of forests on rainfall and the probable effect of *déboisement* in agriculture in Mauritius, A. Walter; climatological diagrams, John Ball; on the double diurnal variations of the velocity of the wind at Nagasaki, Y. Tsuiji; the amount of radium emanation in the atmosphere, J. Satterly.

A CIRCULAR letter has been issued by the British Executive Committee of the International Hygiene Exhibition, to be held in Dresden this year, directing attention to the fact that the British Government has declined the invitation to participate in the exhibition. All the chief States of the world, with the single exception of Great Britain, have accepted the invitation, and have voted substantial sums in aid thereof. The British committee is therefore appealing for 10,000*l.*, which is necessary if Britain is to be represented at the exhibition. Contributions, or promises thereof, should be sent immediately to the secretary, 47, Victoria Street, S.W.

IN a letter to the *Times*, January 11, the chairman (the Bishop of Ripon) and the executive committee of the National League for Physical Education and Improvement direct attention to three leaflets issued by the league dealing with the question of a pure milk supply. These have been prepared by Sir John McFadyean, Prof. Simpson, Mr. F. E. Freemantle, and Dr. J. F. Sykes. One leaflet, intended for "farmers and other milk producers," contains advice upon the care of cows, the precautions to be observed by the milkers, the treatment of the cowsheds, the cleansing of utensils, storage, and the danger of human infection. In a second leaflet, "distributors and retailers" are informed of the steps which they should take with regard to dairies and milk shops, infection, contamination, and souring, storage, and sale, utensils, and cleanliness during delivery. The third leaflet contains a number of hints for the benefit of "housewives and all consumers of milk."

AN interesting observation, dealing with a very obscure phenomenon of alcoholic fermentation, was communicated at a meeting of the Institute of Brewing on January 9 by Mr. O. Overbeck. In endeavouring to prepare a non-alcoholic beer by removing the alcohol from ordinary beer by a stream of carbon dioxide, Mr. Overbeck states that he found that the beer after this treatment recovered a part of its alcohol content when cooled and aërated with carbon dioxide. Thus, beers which after the removal of alcohol contained only 0·2 per cent. of this substance were found after treatment with carbon dioxide in the cold to contain as much as 1 to 1·5 and even 2 per cent. As the liquids were in all cases practically free from yeast, this remarkable production of alcohol cannot easily be explained in the light of our present knowledge. It may be due to some purely chemical effect or to the presence of some unsuspected ferment in the beer, the action of which becomes noticeable under the conditions of the experiment. Confirmation of the observations and further experiments on the nature of the phenomenon will be awaited with great interest.

THE scientific career of Col. George Strahan, who died last week at seventy-one years of age, is described in *The Times* of January 16, as follows: "After serving for a short time in the Irrigation Branch of the Public Works Department in India he was appointed to the Survey Department, in which he continued for the rest of his service. The early portion of his survey career was passed in the Topographical Branch, and many thousand square miles of country in Rajputana and Mysore, as well as in other parts, were surveyed by him and the officers under him. In later years he was employed in the electric determination of longitudes in India and between India and Greenwich, for which work he was specially suited. He rose to be Superintendent of the Great Trigonometrical Survey, and also acted for a short time as Surveyor-General."

TIME was when the expression "the tsetse-fly" was understood to mean simply the species *Glossina morsitans*, Westwood. Indeed, the name is still often used in this sense by many writers; not long ago Prof. Kleine created a sensation in the daily Press by the statement that "the tsetse" did not transmit sleeping sickness, meaning, thereby, *G. morsitans*, but producing the mistaken impression that he had proved *G. palpalis* to be innocent in the matter of spreading the disease. One newspaper even went so far as to state that Kleine had disproved any connection between *G. palpalis* and sleeping sickness. Austen, in his standard monograph of the genus Glossina, recognised seven species of tsetses, and acknowledged, subsequently, the validity of an eighth, *G. tachinoides*, Westw. In a paper noticed recently in NATURE (December 29, 1910, p. 279), Mr. Newstead brings the number of

species up to eleven, and proposes to distribute them amongst three distinct genera. The problems involved are by no means of purely academic interest, but have the utmost practical importance from the known fact that different species of tsetses are instrumental in transmitting the different species of trypanosomes that produce diseases in man and animals, and it is a matter of urgent necessity to determine exactly the various species of these flies and the limits of their distribution.

IN its issue of January 6, the *Times* announces the grant by the Treasury of 40,000*l.* to the Board of Agriculture and Fisheries for the encouragement of light horse breeding in Great Britain. In administering the grant, the Board will have the assistance of a special Advisory Council. The purposes of the grant are five in number, namely :—(1) the award of premiums to stallions; (2) awards for the purchase of half-bred working brood-mares for location in specified districts; (3) free nominations for suitable mares for service by premium or approved stallions; (4) the purchase—for re-sale—of stallions; (5) the voluntary registration of stallions. The awards to stallions will be of two classes, viz. King's premiums and the Board's premiums, the former to be given to stallions at the ensuing spring show in London, and the latter to animals exhibited at other spring shows or selected by the Board. In an article on the grant in the *Daily Telegraph* of January 11, it is stated that certain authorities consider that it will increase the supply of hunters, cobs, &c., and ask what means are provided to create a demand for this increased stock. Owing to the steady development of motor traction, the demand for light horses is not increasing, and will probably become still smaller, so that unless the War Office is prepared to increase largely its purchases, it is difficult to see where breeders are to find a market.

PART ix. of the fifth volume of the Annals of the South African Museum is devoted to a revised list of the local reptiles and amphibians, with descriptions of new species, by Mr. G. A. Boulenger. In connection with this may be mentioned a list of East African reptiles and amphibians, by Mr. S. E. Meek, published by the Field Museum at Chicago (Zool. Ser., vol. vii., No. 11), based on a collection made from 1905 to 1907.

ACCORDING to the *Egyptian Morning News* of December 20, 1910, Captain Stanley Flower has been unusually successful in his eleventh collecting trip to the Sudan, from which he returned with no fewer than 170 live animals for the zoological gardens at Giza, together with a number of museum specimens. The rarities include a Sudani galago (*Galago teng*), a white-tailed mongoose in which the whole tail is (abnormally) black, and a cow buffalo from the Blue Nile, the last-mentioned race being already represented in the gardens by a bull.

IN our own Zoological Gardens it is intended to display a special exhibition of African animals during the coming summer. Some out of a series of birds collected for the King were received at the gardens a few months ago, and it is announced in the *Field* of January 7 that half a dozen mammals brought home by H.R.H. the Duke of Connaught. These include a couple of meerkets, two specimens of the Cape zorille, or muishund, as the animal is called by the Boers, a Sykes's guenon, and a Malagasy ring-tailed lemur. These animals were presented to Princess Patricia of Connaught by the Chief Lewanika.

IN *British Birds* for January, Messrs. Witherby and Hartert, after referring to the distinctness of the English jay (*Garrulus glandarius rufitergum*) from the typical Continental representative of the species, announce that, in their opinion, the Irish jay is likewise entitled to rank as a local race. Compared with British specimens, the Irish jay (*G. g. hibernicus*) has the feathers of the sides of the head and ear-crests markedly darker and more rufous, while there is a tendency to a similar darkening all over the under-parts, and the crest is conspicuously darker. The Irish jay is mainly restricted to Leinster and the adjacent districts of Munster, although of late years it has spread into the south of Ulster. The Irish representatives of two other birds—the water ouzel and the coal titmouse—have recently been described as local forms. Whether we are any the forwarder for such splitting-up of species may be a question.

WE are indebted to Mr. W. H. Shrubsole for a copy of an unpublished article on the contrast between the protection accorded to useful birds in Hungary and Great Britain. The Hungarian Government employs the services of an ornithological expert, and from the results thereby attained has been enabled to draw up a series of enactments which appear admirably adapted for the protection of all species beneficial to the agriculturist. Heavy fines are enacted on the conviction of offenders against these Acts, while rewards are offered to the writers of the best essays on bird-protection. Other paragraphs in the Acts prohibit the possession or transport of scheduled birds or their nests and eggs. On the other hand, the British Acts for the protection of wild birds are, in the author's opinion, altogether inadequate. Attention is also directed to the use in Italy of huge nets—some half a mile in length and of great height—for the capture of swallows and other migratory birds.

IN the issue of NATURE of October 6 last (vol. lxxxiv., p. 428) a letter was published from Prof. T. D. A. Cockerell containing some interesting information concerning the fur trade. Prof. Cockerell gave extracts from a detailed synonymy contained in the retail catalogue of an important American firm dealing in furs, which showed how far the furs bought from shops may be identified from the names under which they are sold. A letter to the *Morning Post* of January 12, from Mr. E. M. Kirwan, raises the same point, and offers a warning to the public in the form of a list showing the proper names of the various furs and the permissible descriptions sanctioned by the Fur and Skin Section of the London Chamber of Commerce and the London Drapers' Chamber of Trade. Mr. Kirwan's list is as follows :—

Name of Fur.	*Permissible Description.*
American sable	Canadian sable or real sable.
Fitch dyed	Sable fitch.
Goats dyed	Bear goat.
Hare dyed	Sable hare or fox hare.
Kids	Caracul kids.
Marmot dyed	Sable marmot, mink marmot, or skunk marmot.
Mink dyed	Sable mink.
Musquash dyed	Mink musquash or sable musquash.
Musquash pulled and dyed	Seal musquash.
Nutria pulled and dyed	Seal nutria.
Nutria pulled, natural	Beaver nutria or otter nutria.
Opossum sheared and dyed	Beaver opossum.
Otter pulled and dyed	Seal otter.
Rabbit dyed	Sable coney.
Rabbit sheared and dyed	Seal coney or musquash coney.
Rabbit, white	Mock ermine.
Rabbit, white, dyed	Chinchilla coney.
Wallaby sheared and dyed	Skunk wallaby.
White hare	Imitation fox or mock fox.
White hairs inserted in foxes and sables	Pointed.

In a recent number (December, 1910) which has reached us of the Leipzig *Neue Weltanschauung* Prof. Max Kassowitz, of Vienna, criticises the views of those biologists who consider that the main cause of the origin of species is to be found in natural selection. His objections are all tolerably familiar. He points out, for example, that the analogy from artificial selection is not complete. The breeder selects characters from motives of curiosity and the like, not because they are useful to the form dealt with, but because they are useful or interesting to himself. Moreover, in order to maintain his artificially produced race, he has to exercise a far more rigid selection than can take place in nature. When left to themselves, such strains rapidly revert. The Lamarckian explanation must be resorted to, not merely for the atrophy and disappearance of disused organs, but also for the enhanced development of frequently used parts. Evidence of this is afforded by Darwin's comparison of the wing and leg bones of tame and wild ducks. If it is once admitted, the author remarks, that the changes produced by use or disuse can pass over to the offspring by means of the germ-plasm, there is no further reason for doubting the general transmissibility of acquired characters or the influence of this principle on every change that takes place in the course of the development of species. Natural selection, he declares, has not hindered the peculiar susceptibility of mankind to certain forms of disease. In these cases the working of a Lamarckian factor can be traced, not of the nature of Darwin's pangenesis, to which there are obvious objections, but more probably a circulation of specific atom-complexes derived from the disintegration of protoplasmic molecules. Prof. Kassowitz's contentions have been heard before, and abundantly answered. Had he taken into account the results of Mendelian research, it is plain that some of them would never have been advanced. The concluding argument of his paper, on the subject of disease toxins, is ingenious, but unconvincing.

A review of the development of the Ligulatæ, *i.e.* the genera Selaginella and Isoetes, communicated by Dr. G. Ritter to *Naturwissenschaftliche Wochenschrift* (December 11, 1910), traverses the investigations by Bruchmann into the various modifications of the prothalli and embryo in Selaginella, and describes similar stages in Isoetes.

The list of seeds of hardy herbaceous plants, shrubs, and trees available for exchange with botanic gardens and regular correspondents, annually published by the director of Kew Gardens, has lately been issued in the usual form as Appendix 1 to the *Kew Bulletin*, 1911. The list is a short one, presumably reflecting the past unfavourable season, during which the gentians and cotoneasters have yielded the best results.

A sketch of the flora of the Samoa Islands is contributed by Dr. F. Vaupel to Engler's *Botanische Jahrbücher* (Beiblatt, No. cii.), with reference to his collections of plants gathered chiefly on the island of Savaii. The flora falls into the Melanesian division of the Malayan region while showing affinities with the floras of Australia and New Zealand. In common with other insular floras cryptogams are abundant, and the ferns supply 200 species as compared with 600 flowering plants. Two of the most typical are *Angiopteris evecta* and the small tree-fern *Todea Fraseri*; *Tmesipteris tannensis*, two species of Psilotum, and *Botrychium daucifolium* are reckoned among the rarer pteridophyta. A unique feature of some of the lagoons is the thick growth of *Acrostichum aureum* alongside the brackish water, and a peculiar vegetation, consisting of a tangle of *Gleichenia dichotoma, Pteris heterophylla*, and *Imperata arundinacea* penetrated by masses of *Lycopodium cernuum*, covers the tufa soil on the plateaux. Among phanerogams, the orchids are well developed, also the dicotyledonous genera Psychotria, Cyrtandra, and Elatostemma.

Bulletin 124 of the West Virginia Experiment Station deals with factors influencing the vigour of incubated chickens. Incubators operated without moisture gave rather better results than those where moisture was supplied, but the author is not prepared to assert that the difference is real. Indeed, this old controversy whether a moist or a dry atmosphere should be maintained in an incubator has not yet been satisfactorily settled. It has been suggested that the chick embryos have a certain power of adapting themselves to different degrees of humidity during their development.

The *Bulletin de la Société d'Encouragement pour l'Industrie nationale* (No. 9) contains an interesting report, by M. Maurice Alfassa, on economic imperialism in Great Britain, in which he deals fully with the efforts now being made to promote cotton growing within the British Empire and to study the problems to which it gives rise. He advises that our African experiments should be closely watched, as some of the conditions are not dissimilar to those obtaining in the French African possessions, and considers that if it is worth our while to try to raise our own cotton it is equally worth while for France.

The current number of the *Agricultural Journal of India* (vol. v., part iv.) is up to its usual level of interest, and contains several well-illustrated articles dealing with native agricultural practices, and with possible improvements on them. Mr. Keatinge gives a well-written account of the rural economy of the Bombay Deccan, both in its western part, where there is a moderate rainfall and a certain amount of irrigation, and where, consequently, good garden crops can be grown, and in its eastern portion, where a heavy black soil occurs, but rainfall and irrigation are both deficient; here the typical crops are *jowari* and cotton. The population naturally follows the water supply; in the western part it is not uncommon to find the cultivator living on his holding and working industriously at it; in the eastern part, however, the cultivators' houses are confined to the villages on account of the public wells, and much less work is done on the fields. A description is given in another article of the new agricultural college at Coimbatore, Madras, and Mr. Gammie reproduces the paper on cotton cultivation in India that he presented to the Brussels Congress last May.

The monthly meteorological chart of the North Atlantic Ocean for January, issued by the *Deutsche Seewarte*, explains the good use made of radiotelegraphy for disseminating weather and storm-warning notices to vessels and small craft in the North and Baltic Seas. (1) The wireless station at Norddeich follows its time signal at 1h. p.m. by a short summary received from the Seewarte of the weather conditions over Europe at 8h. a.m., with forecasts for the above-mentioned localities. (2) When necessary, storm-warnings are sent to the same station, and are received by vessels having wireless apparatus and repeated by them by means of day and night signals. (3) Storm-warnings are also sent by the Seewarte to the fishery cruiser in the North Sea, and repeated by ordinary signals by day, and at night by searchlight, for the benefit of fishing-boats. (4) Storm-warnings intended only for the Baltic coast are disseminated in a similar manner by the wireless station at Bülk.

The descent of a sphere in a viscous liquid was studied by Basset in 1887, but the equation of motion was only integrated by successive approximation. Since that time the subject has been discussed in the *Atti dei Lincei* for 1907 by Prof. Picciati and Dr. Tommaso Boggio. In the *Quarterly Journal of Pure and Applied Mathematics*, No. 164 (1910), Mr. Basset gives a general investigation of the problem, based on the work of the two Italian writers. One notable feature of the work is that the viscosity enters into the Stokes' current-function solution in a way that it did not enter in the earlier solutions of the problems.

In a paper on the imaginary in geometry, contributed to the University Studies, Lincoln, Nebraska, x., 1., Prof. Ellery W. Davis discusses geometrical properties connected with a mode of representing points in two-dimensional space the coordinates of which are both complex variables. He takes a so-called "black" point P' the coordinates of which are the real parts of the variables, and from it draws a "red vector" the compounds of which are the imaginary parts, the extremity being a "blue" point P'' the coordinates of which measure the real parts *plus* the imaginary coefficients.

The *Revue scientifique* for December 31, 1910, contains the address delivered by M. H. Le Chatelier at the Collège de France on December 18 in connection with the ceremonies commemorating the centenary of the birth of Regnault. In the course of his address M. Le Chatelier referred to several facts in the early life of Regnault not generally known. An orphan without means, he spent his youth as an assistant in a fancy bazaar, and at the age of twenty-two entered as a student at the Ecole des Mines. He rose immediately to a prominent position as one of the most promising pupils, and at the qualifying examinations in May, 1834, after two years only of study, he passed brilliantly. For some strange reason the Government refused to nominate him student engineer along with his successful fellow-students, but insisted on a further two years' course at the Ecole. During this period he raised himself by his chemical researches to the front rank of chemists, and it was only on the appointment of a Government commission on the steam engine in 1843 that he commenced that series of measurements in the domain of physics which for accuracy remained unique for half a century.

In Nature for August, 11, 1910, we directed the attention of our readers to a communication to the Vienna Academy of Sciences, which appeared in the *Physikalische Zeitschrift* for July 15, and gave a preliminary account of the measurements of quantities of electricity less than the electron or "atom of electricity," by Dr. F. Ehrenhaft, of the University of Vienna. The complete account of the measurements is now available in the *Sitzungsberichte* of the academy for May, 1910. Since our previous note, Prof. Millikan has published in *Science* for September, 1910, an account of his measurements of the charges on drops of oil produced by an "atomiser" or sprayer. He concludes from them that the atomic charge of electricity is $4 \cdot 9 \times 10^{-10}$ electrostatic units. Dr. Ehrenhaft points out in his complete paper that many of Prof. Millikin's results do not fit in with his conclusion. The June (1910) number of the *Sitzungsberichte* contains Dr. K. Przibram's measurements of the charges on the fine particles of mists produced by electrolysis of a solution of potassium hydrate, by the spark discharge in moist air, by hydrochloric acid, or by phosphorus in moist air. His results confirm those of Dr. Ehrenhaft, so that there is a serious difference of opinion between the Viennese and other observers on the fundamental question of the existence of atomic charges of electricity.

The paper read by Major O'Meara, C.M.G., on submarine cables for long-distance telephone circuits, at the Institution of Electrical Engineers on January 12, when Mr. Herbert Samuel, the Postmaster-General, was present, will be welcomed by electrical engineers. The paper gave in the first place a brief description of the first telephone cable of notable length; and after touching shortly on the differences in subsequent cables laid across the Channel—which varied very little from the original—proceeded to describe the latest telephone cable laid last year between Dover and Cape Gris Nez. This cable was specially designed to improve the clearness of speech over the line, and also to enable more distant parts of the Continent to be in direct communication with England. To overcome the indistinctness, to which all long-distance telephone cables are liable, small induction coils are inserted in the cable. The theory of this was first propounded by Messrs. Heaviside and Pupin, and is embodied in the present "coil loaded" cable. Two double coils are required for the four conductors and are inserted at a distance of one knot (1·153 miles) apart, each coil being just under six ohms resistance. The two coils nearest the ends of the cable are only half a knot from the terminal instruments, this having been found to give the best results. It is essential, having regard to the maintenance of these cables, that the coils should be evenly distributed, as in repairing cables intermediate lengths have to be inserted. So long as the coil spacing is not altered beyond five per cent. on either side, no noticeable impairment to speech will take place. The importance of this fact will be appreciated when the list of repairs on existing telephone cables is taken into account. It was doubtful when the cable was designed as to how the mechanical difficulty of securing the coils in the cable would be overcome, owing to the increase of size at the points where the coils are inserted, and also the difficulty of the increased thicknesses passing over the drums when laying the cable. These difficulties were successfully overcome and a special paying-out drum was employed, the cable being payed out without passing it under the dynamometer wheel. The paper gives a full description of the laying of the cable; and the complete specification of the cable is contained in one of the many appendices attached thereto. Under the previous existing conditions, conversation could be carried on over a distance of 250 miles, but with the new "coil-loaded" cable a distance of 850 miles is possible.

The current number (January 10) of the *Comptes rendus* of the Paris Academy contains an account of a new general method of preparing anhydrous metallic chlorides, by Ed. Chauvenet. The method recently proposed by Matignon and Bourion, based on the use of a mixture of chlorine and sulphur chloride, is efficient, but the method now proposed is simpler in that phosgene is used, a substance commercially obtainable in the liquid form in bombs. The oxide of the metal is placed in a boat, and heated in a slow stream of the carbonyl chloride; the metallic chloride, if it is volatile, sublimes a little in advance of the boat in crystals, the temperature required varying between 350° C. and 650° C. Of the numerous oxides tried only silica was unacted upon, a fact which will be of service in separating siilca from other metallic oxides, such as the oxides of tungsten, tantalum, or titanium. Titanium and tungsten furnished oxychlorides, but in all the other cases examined the pure anhydrous chloride was obtained.

At the students' meeting of the Institution of Civil Engineers, held on January 6, Mr. G. F. Davidson read a

paper entitled "The Measurement of Boiler Deformations." The author described a novel and ingenious method of ascertaining the deformation and corresponding stress by means of a mirror attached to the point on the shell to be examined and a telescope sighted on to the mirror, the reflected reading of a graduated scale being observed and the angular deflection thereby ascertained.

WE learn from a note in the *Builder* for January 13 that M. Knauth, in reporting on the settlement in Strassburg Cathedral, states that the chief cause is the defective condition of the foundations beneath the north tower. The foundations consist of two walls running north to south and east to west, and are constructed of rubble and cement on argillaceous soil, in which some timber piles had been driven. The piles are badly decayed, and the interior pillar of the tower is said to be virtually unsupported for a length of 2 metres, as a layer of vegetable earth is interposed between the foundations and the base of the pillar. Like many fabrics of the same class in this and other countries, Strassburg Cathedral was built in different epochs, one result being that the foundations have now to carry loads greater than those contemplated by the original designer. This point is illustrated by the statement that the present foundation load is upwards of 25 tons per square foot. The remedy proposed is the underpinning of all defective foundations.

A BLUE-BOOK has just been issued giving account of the engine trials at the National Physical Laboratory for the award of the prize of 1000*l.* offered by Mr. Patrick Y. Alexander. These trials form the subject of an article in *Engineering* for January 13, from which we gather that six engines were entered, but only three arrived before the date fixed. These were:—(1) the Wolseley Tool and Motor-car Company, Birmingham; (2) Messrs. Humber; and (3) the Aster Engineering Company, Wembley Park (entered by Green's Motor Patents Syndicate). Not one of these engines was able to fulfil the conditions of the test fully. The first was pulled up by a leak in the copper oil pipe leading from the pump to the oil well, a defect which led to other mishaps. The Humber motor ran steadily at 37 brake-horse-power at 1224 revolutions per minute for $11\frac{1}{4}$ hours, and then stopped suddenly with one of the cylinders broken off and two connecting rods buckled. The Green engine was more fortunate. It had to stop for a new sparking plug, and then ran, making approximately 31·5 brake-horse-power at 1213 revolutions per minute, until the completion of the twenty-four hours' run. In a special test of seven minutes, the motor developed 36·4 brake-horse-power at 1390 revolutions per minute. The prize has not been awarded, but we understand that the donor has generously presented a cheque for 200*l.* to the makers of the Green engine, which came nearest to the conditions of award.

MESSRS. J. AND A. CHURCHILL have just ready for publication a new edition of another volume of "Allen's Commercial Organic Analysis." It is vol. iv. under the new arrangement, and has been rewritten under the editorship of Mr. W. A. Davis and Mr. S. S. Sadtler.

MESSRS. WILLIAMS AND NORGATE announce for early publication a translation into English of Prof. Wilhelm Ostwald's work entitled "Natural Philosophy." This work, the translation of which will be revised by the author, gives a *résumé* of modern natural philosophy, based not upon metaphysics, but upon the sciences; and it aims at providing a complete synthesis of the results of the specialisation of last century.

OUR ASTRONOMICAL COLUMN.

NOVA LACERTÆ.—A brief note in No. 4464 of the *Astronomische Nachrichten* announces that Prof. Max Wolf has found a twelfth- or thirteenth-magnitude star in the position of Nova Lacertæ on plates taken some years ago at the Königstuhl Observatory. The previous presence of a faint object does not, of course, necessarily preclude the star discovered by Mr. Espin from being of the "novæ" type, although in most cases the pre-existence of matter in the identical position is assumed rather than demonstrated; before the catastrophe which produces the extraordinary outburst of light, the object is usually too faint to be detected on our photographs.

More precise spectrum observations than those yet published will permit us to determine whether the outburst was of the catastrophic nature which produces typical "novæ" or whether it is simply a case of a peculiar variable; up to the present, the unfavourable English skies, combined with the faintness of the object, have prevented definitive observations. Seven or eight bright lines have been observed at the Cambridge Observatory, and it is worthy of note that they have not the broad appearance of lines seen in the spectra of novæ.

It is to be regretted that the "nova" was not discovered earlier, for we understand that Prof. Pickering has found images of it, on plates taken about the end of November, 1910, showing it to be of approximately the same photographic magnitude (about 5·0) as the star 9 Lacertæ shown on the chart which we gave in last week's issue; on December 30, 1910, its magnitude was about 7·0. Referring to these facts, at the Newcastle Astronomical Society, Mr. Espin pointed out that for some three weeks the star was visible to the naked eye, yet no one observed it. It was not visible on the Harvard plates on November 19, so that its rise to the fifth magnitude must have been rapid. Mr. Espin suggests that these observations conclusively prove the object to be a real nova. A plate taken at Harvard in December, 1887, although it shows faint stars, shows no trace of the nova.

Mr. Bellamy estimated the visual magnitude on January 2 as 7·5, and recorded the colour as orange. It will probably be found, as with other novæ, that there is a certain difference between the photographic and visual magnitudes, due to the presence of radiations visually inert, and this is suggested by the fact, stated by the Astronomer Royal, that the photographs taken at Greenwich show the image of the nova to be different in appearance from the other star images shown on the same plates.

THE ORBITS OF SEVERAL SPECTROSCOPIC BINARIES.—Nos. 5–8, vol. ii., of the Publications of the Allegheny Observatory contain the discussions of the orbits of various spectroscopic binaries under investigation at the observatory.

In No. 5 Mr. R. H. Baker discusses the measures of the spectrum of 30 H. Ursæ Majoris as shown on fifty plates taken with the Mellon spectrograph in 1908–10. He finds that the observations are not so well satisfied by the preliminary curve computed on the assumption of simple elliptic motion, but the agreement is improved by the introduction of a secondary oscillation. As there is no trace of the secondary component on any of the plates, the resulting orbit must be accepted as preliminary; the period is 11·5832 days.

Thirty spectrograms of 57 Cygni are discussed by the same observer in No. 6 of the Publications. These were taken in 1909, and a comparison of the results with earlier ones secured in 1903 establishes the period as 2·8546 days. The orbits of both primary and secondary components are given separately and then combined, and it appears that the masses are not very different.

Mr. Baker also reverts to the discussion of θ Aquilæ, in No. 7, which, from a comparison of observations made by M. Deslandres in 1901–2 with later ones made in 1907–8 by Mr. Baker, appeared to have a variable period. The latter observer now finds that the two observations of 1901 are probably erroneous, and that the period of θ Aquilæ (17·1245 days) is constant. The orbit as published is derived from single-prism plates, where the lines are confused, and can be only an approximation to the true elements; the star is bright enough, however, for

three-prism spectrographs, which would separate the lines and enable better elements to be derived.

In No. 8 Mr. F. C. Jordan discusses the orbit of π Andromedæ from measures of 111 plates taken with the Mellon spectrograph between August, 1907, and October, 1909, and derives a period of 143·67 days. A point of special interest is that this binary is a helium star with a long period, and it has been shown that helium binaries are sharply divided into long and short periods. The latter are generally less than one month, whilst the shortest of the former class is 116 days. The increase of eccentricity with period is also notable, the mean periods for the two groups being 8·38 and 147·1 days, whilst the corresponding mean eccentricities are 0·19 and 0·41 respectively. π Andromedæ is a notable example, the eccentricity of its orbit being 0·58. The point is a very striking one, but the data are, as yet, too meagre to warrant speculation concerning its possible significance.

THE DISCOVERY OF KEPLER'S LAWS.—The history of Kepler's labours in working out his three laws of planetary motions is interestingly told by M. Bigourdan in No. 23 of the *Revue générale des Sciences*. Refused as a divine, Kepler pursued his study of mathematics, and was appointed professor at Gratz in 1594, then being twenty-three years of age. But in 1599 he was, as a Protestant, expelled from Styria, and accepted a post under Tycho Brahe. For a number of years he endeavoured to fit Tycho Brahe's wonderfully accurate observations into the geocentric system which the latter upheld, but without success, for there was always a residual error in latitude of 8′ or 9′, and this amount Kepler believed to be impossible in such careful observations. Then, after the master's death, he worked away at the heliocentric idea, and succeeded, eventually, in discovering the laws which are the basis of our knowledge of orbital motions. In his paper M. Bigourdan introduces many other points of interest concerning Kepler's life and methods.

BRIGHT BOLIDES.—The apparitions of several bright bolides during the latter part of 1910 are recorded in Nos. 37–38 of the *Gazette astronomique* by M. Birkenstock, director of the Bureau Central Météorique. One, recorded by several observers at different stations, appeared about 8.45 (C.E.T.) on August 19, and, as seen at Novi, was about three-quarters the size of the full moon; it then split into two parts, each half the size of the moon, and, leaving a train, disappeared after a flight which lasted three seconds. Other bolides were recorded on September 9 and 23, and October 8.

THE ASTROGRAPHIC CATALOGUE, CATANIA ZONES.—We have received part i., vol. vii., of the Catania astrographic catalogue, giving the positions of 8855 stars. These have been determined from fifteen plates covering the region 0h. to 3h. in R.A., and $+52°$ to $+54°$ in declination; excluding repetitions, the net number of new positions is 7872. Tables for the geometrical corrections for zone $+53°$, with their arguments, and ten-year precession constants up to the year 2000, are also given.

CONFERENCES OF MATHEMATICAL TEACHERS AND OF PUBLIC SCHOOL SCIENCE MASTERS.

THE annual meeting of the Mathematical Association was held at the London Day Training College on January 11, and the science masters met in the same building on January 11 and 12. The officials of the college and of the respective associations made admirable arrangements, which conduced to the success of the gatherings both from the working and the social aspects.

Prof. H. H. Turner presided at the mathematical meetings, and in his address gave a historical *résumé* of the recent advance of "the astronomical regiment" under the leadership of Pickering, Stratton, Perrine, Melotte, and Cowell. He described the discoveries of the new satellites of Saturn and Jupiter, and the revelations into the past of planets which resulted from an examination of the orbits of these satellites. The members present, mostly teachers in schools, were greatly interested in the "news from the front" of the mathematical army. The annual report showed a large increase in membership and an expansion of the *Mathematical Gazette*.

Mr. G. Goodwill read a paper on the teaching of elementary mechanics, in which he recommended that dynamics should precede statics, and that the idea of change of velocity should be treated as a basal concept necessary for a proper approach to the subject. He showed an extremely simple ballistic pendulum used for measurements of change of momentum. By abandoning the usual uniplanar arrangement, he has at once simplified the exercises and tangibly increased their didactic value.

Canon J. M. Wilson described two fragments of ancient geometrical treatises found in the Worcester Cathedral Library. The first was written by Gerbert, who became Pope Sylvester II. in 979. At that time Euclid was known only to the Moors, and Gerbert failed in his attempt to enter the University of Granada. The second fragment dated from the early part of the twelfth century, and was written by a monk of Bath named Adelhard or Æthelhard. He succeeded in learning Arabic and entering the Universities of Granada, Cordova, and Seville by professing to be a Mohammedan. The fragment discovered by Canon Wilson proved to be part of a translation of Euclid from the Arabic into Latin. This translation was used in all the schools of Europe until 1583, when Euclid's own Greek text became known.

Mr. A. W. Siddons presented an important report by the Mathematical Association Committee "On the Teaching of Algebra and Trigonometry" (published by Bell and Sons, price 3*d*.). The report dealt with the function of algebra in the school curriculum for boys who were not likely to specialise in mathematics, and aimed particularly at giving teachers opportunity to develop with their pupils mathematical ideas of great educational value—ideas drawn from mechanics, mensuration, solid geometry, infinitesimal calculus, and more especially from numerical trigonometry. Mr. F. W. Dobbs (Eton) thought the recommendations went too far, whereas Mr. Barnard said that the Rugby masters thought the suggested syllabus was inadequate. Other speakers supported the views of the authors, and the general effect of the discussion was to strengthen the hands of the committee and to endorse their conclusions. The meeting referred to the committee a paper read by Mr. C. V. Durell, who urged that much commercial arithmetic should be omitted in order to find time for work more productive of mathematical intelligence.

Among interesting exhibits were a projection of the earth's surface on a cube, shown by Prof. Turner, a celestial cylinder by Dr. T. P. Nunn, and apparatus illustrating Mr. Goodwill's paper. Prof. E. W. Hobson has accepted the office of president for the coming year.

Sir E. Ray Lankester opened the science masters' meeting with an address upon "Compulsory Science *versus* Compulsory Greek." The main question he desired to raise was whether the right choice of subjects for study was made in our public schools, and whether it was right and proper, as he should suggest, to cease altogether the cumbrous efforts to teach the Greek language to schoolboys and to substitute for it as a regular and necessary part of the curriculum a well-considered, duly adapted, and skilfully designed course of instruction in natural science—using that term in the most comprehensive sense. The results of education were not transmitted by physiological heredity. Every individual born had to begin its education on a blank sheet. But man had created for himself a gigantic and overpowering possession, a sort of physical envelope of customs, taboos, traditions, laws and knowledge, which, though not transmitted to new individuals at birth as part of their structure, was yet a heritage by which man was educated. This heritage was put into his possession by gesture; by word spoken, written, or printed; by law; by the training given in the nursery and school; and by the experience of life. Individuals did not start equal, and it was the business of the educator to ascertain the various degrees of educability in the young and to adapt the course of education administered to them to their varying aptitudes. The well-educated man was he who had been enabled most fully to benefit by the accumulated inheritance of human knowledge and experience, and to enter on manhood as the heir of all the ages. The true Greek spirit was

realised, was, in fact, reborn, and existed in our present phase of civilisation in the splendid creations and the self-reliant, hopeful, and sober enthusiasm of the men of science of the nineteenth century. The Greeks, were they able to visit us now, would have nothing but contempt for our Greek compulsionists. At the conclusion of his address he proposed a possible and desirable course of school education when compulsory science had banished the usurper—compulsory Greek.

Sir William Tilden, in proposing a vote of thanks, pointed out the advances made in the schools during recent years, and mentioned that the boys who were compelled to learn Greek were fewer than those obliged to study science.

Sir J. J. Thomson was elected president for the coming year.

Mr. A. Vassall read a paper on the education of medical students, and explained the powers which the General Medical Council actually possess, and referred to further powers to which the General Medical Council appear to lay claim. He deprecated any attempt on the part of the Medical Council to dictate a syllabus of general, as distinct from technical, education. Prof. Osler, in the course of the discussion, supported the view that the early scientific training of medical students could be undertaken by public schools.

In his paper on the experimental determination of the equivalent of magnesium, Mr. W. M. Hooton explained the complex reactions which actually occur when magnesium is heated in a porcelain crucible. As usually performed, the products include, in addition to the oxide of the metal, magnesium nitride and silicide, carbon, and possibly silicon. We should like to see more papers of this type, for there are many text-book exercises in vogue, both in class and in examinations, which call for careful revision. Mr. Hooton did not only succeed in the analytical investigation—he further developed a revised and satisfactory manner of performing this quantitative exercise which is of considerable value in an elementary course.

A good discussion was evoked by Mr. Eggar's paper on teaching English in connection with science lessons. The opener and Mr. Lewis, who followed, dwelt mainly on the faults prevalent in boys' notes, but subsequent speakers offered constructive suggestions for improvement. Prof. R. A. Gregory asked that more prominence be given to the romance of science. Scientific work of the last ten years had been concentrated on the drudgery of the laboratory, and the inspiration of early days had been neglected. This neglect was detrimental to scientific progress, and he wished schools more effectually to cultivate interest in the higher aspects of science. Dr. Gow (Westminster) said that the difficulty in regard to accurate language was felt in every branch of school teaching. After a long and interesting debate, the chairman suggested the possibility of a correlation report, to be drawn up in association with teachers of English.

Another useful debate arose on the question of "Wave Theory *versus* Rays" in the teaching of light, the respective protagonists being Mr. J. Talbot and Mr. C. F. Mott. Dr. T. P. Nunn uttered a needed *caveat* against dogmatic exposition of ideas relating to the æther, and showed how simply some of the most useful formulæ of optics could be obtained by heuristic lessons without unverified assumptions. The outcome of the discussion appeared to us to be that it was possible to secure the presentation of useful concepts of the wave theory to a class of boys of age sixteen, and that the process was valuable educationally.

Mr. R. W. Sloley contributed a paper on teaching concepts of energy and potential.

The exhibition of scientific apparatus and books was of large extent and good quality. Twelve of the best known firms in the trade had arranged extensive exhibits, which included not a few novelties. There were also about forty pieces of apparatus contributed by the members of the association, in some instances the handiwork of pupils. Half a dozen leading publishers sent their latest books on science subjects, and it was satisfactory to note the large proportion of advanced books which were shown. Most of the members and guests devoted a considerable time to the examination of the exhibits, which were well displayed, and suggested many practical aids to work in laboratory and lecture-room.

In promoting social intercourse among science and mathematical masters from various parts of the country, this year's congress was even more successful than its predecessors. Much of the credit for this must be given to Mr. D. J. P. Berridge, who is retiring from the office of honorary secretary after giving to the Public School Science Masters' Association several years of hard, successful work.

G. F. D.

GEOLOGY OF THE BRITISH ISLES.

AMONG the later memoirs of the Geological Survey of Great Britain, for which Mr. T. Fisher Unwin is wholesale agent, is that accompanying Sheet 142 of the 1-inch map, on "The Geology of the Melton Mowbray District and South-east Nottinghamshire," by Messrs. Lamplugh, Gibson, Wedd, Sherlock, and Smith (price 2*s*. 3*d*.). The map (price 1*s*. 6*d*.) is a good one for showing the irregular distribution of boulder-clay across the ridge of Middle Lias, and its cessation in the Vale of Belvoir. Rhætic beds are recognised above the "tea-green marls" of the Keuper in the north and west. In the memoir it is pointed out that the Vale of Belvoir must have lain in the glaciated region, but was an area of stripping rather than of accumulation. Melton Mowbray probably stands over a concealed coalfield, which has been proved by borings to the north-west, and which may extend far to the south-east.

The tenth part of "The Geology of the South Wales Coalfield" has also been issued by the Survey, and is written by Messrs. Strahan, Cantrill, Dixon, and Thomas (price 2*s*.). It accompanies Sheet 229 of the map, which appears both in "solid" and drift editions. Part of the area was surveyed by Mr. B. S. N. Wilkinson, now senior geologist on the Irish Survey. The features of economic importance are dealt with in the description of the coalfield, which appears in the south-east of the map, and in chapter xv., on metallic ores, building stones, &c. The subdivisions of the Ordovician strata, including the Llanvirn series, are now shown in considerable detail on the colour-printed map, and Upper Tremadoc beds are also recognised in a band south of Carmarthen town. The Old Red Sandstone makes distinctly hilly country along the coast, and is cut across its strike by the main streams. The journey westward from Kidwelly thus involves two picturesque but sometimes breezy ferries, while the railway runs in milder Ordovician country to the north. The drift map shows patchy remnants of a sheet of boulder-clay, deposited by ice moving westward and southward down the Towy Valley, but disregarding its local windings. In the extreme west of the area ice probably came in from the north-west. It is suggested (p. 147) that the chalk-flints which are fairly common in the glacial gravels were derived from Cainozoic deposits which have been swept away.

Messrs. Lamplugh and Gibson have described "The Geology of the Country around Nottingham" (1910, price 2*s*.), with an accompanying map, specially composed of parts of four sheets (price 1*s*. 6*d*.). Attention is directed to points where local research is still required, a feature of the memoir that will be welcomed in a district famous for its amateur geologists. This official work has, indeed, been undertaken in an educational spirit, and is certain to meet with a gratifying response.

Mr. H. J. Osborne White writes on "The Geology of the Country around Alresford" (1910, price 2*s*.), and a colour-printed reproduction (price 1*s*. 6*d*.) is now issued of the drift-sheet No. 300, first published in 1898. The district lies on the edge of the chalk of Salisbury Plain, which is followed so picturesquely on the east by the high commons of the Lower Greensand beyond Lyss and Kingsley. A memoir describing the country that includes the village of Selborne, nestling in its vale at the foot of the Lower Chalk escarpment, will appeal to many naturalists. Mr. O. White pays special attention to the zoning of the Chalk. Types of soil and questions of water supply are dealt with in the concluding pages, and there are some interesting notes on river-capture (pp. 74 and 75).

The valuable series of memoirs on water supply is continued by one on Oxfordshire, by Mr. R. H. Tiddeman (1910, price 2s. 3d.), and one on Hampshire and the Isle of Wight, by Mr. W. Whitaker (1910, price 5s.). Dr. H. R. Mill contributes the chapters on the rainfall of the areas.

The Survey's "Summary of Progress" for 1909 (1910, price 1s.) contains, as usual, a record of new observations, of which further details may be expected later. A number of Devonian inliers have been found in the Culm-measure area west of Dartmoor. Mr. Clement Reid is prepared to correlate the well-known Bovey beds, with which even Playfair was acquainted, with the lignites of the Rhine, and to assign them to the Upper Oligocene. They thus fill a gap in British geology above the Hamstead beds of the Hampshire basin. "The Bovey flora . . . seems to be essentially the flora of the granite-ravines, with the admixture of a very few aquatic forms. . . . Marsh-plants are exceedingly rare" (p. 18). The additions to our knowledge of the Isle of Mull are conspicuous (pp. 26–38). Upper Lias and Middle Jurassic beds have now been discovered on Loch Don, thus filling part of the gap that occurs at Carsaig between the representatives of the Jurassic and the Cretaceous (see also p. 57). "Cornstones" in the Trias of Morvern (p. 35) indicate arid conditions; and Mr. Maufe's tropical experiences are here used to advantage. Detailed analyses of Devonshire clays, derived from granite, are given on p. 59. The titanium dioxide is usually more than 1 per cent., while zirconia and vanadium sesquioxide are each about 0·03 per cent.

Mr. L. Richardson contributes an elaborate and well-illustrated paper on "The Inferior Oolite and contiguous Deposits of the South Cotteswolds" to the Proceedings of the Cotteswold Naturalists' Field Club, vol. xvii., 1910, p. 63. He also discusses some of the hollows on the Cotteswold scarp in a paper on glacial features (*ibid.*, p. 40), and shows how the Ice age has probably left its traces in the land-forms here, as in North Wales. Mr. Richardson read his paper in 1909, and about the same time Prof. W. M. Davis, to whose work on Snowdon he refers, contributed a short paper on "The Valleys of the Cotswold Hills" to the Proceedings of the Geologists' Association (vol. xxi., p. 150). He points out that "when the curves of a stream are too small for the curves of its valley, a diminution of stream volume is to be inferred." The Evenlode and other valleys on the back of the Cotteswolds are too large for their present streams, and this may be due to their beheading by the recession of the escarpment. But the author suggests that they may formerly have been occupied by water escaping from small lakes between an ice-front in the Liassic lowland and the face of the Cotteswold cuesta. Such water would select the pre-glacial valleys, and would enlarge them.

In the same journal (vol. xxi., p. 333) Messrs. C. R. Bower and J. R. Farmery add to our knowledge of "The Zones of the Lower Chalk of Lincolnshire," working upwards from the top of the Red Chalk or Hunstanton Limestone. They see cause to differ as to the selection of zone-fossils made by previous writers, and choose, going upwards, *Holaster subglobosus*, *Terebratulina ornata*, and *Holaster trecensis*. Forty-three species are added to the records from these beds, and a plate is given to show the range of form in *Discoidea cylindrica*, from a pentagonal type in the lower zone to a flattened one, with a circular base, in the upper zone. Messrs. J. G. Hamling and T. Rogers (*ibid.*, 1910, p. 451) furnish a new coloured geological map of North Devon, on the scale of three-quarters of an inch to one mile.

In the same volume of the Proceedings of the Geologists' Association, p. 489, Mr. M. A. C. Hinton summarises his work on the British fossil voles and lemmings, and makes some very interesting remarks on the climatic conditions accompanying the maximum extension of ice in our islands. He regards the "Great Ice Age" in Britain as due to "glaciers formed in the mountainous districts," though it is not clear why Britain in this respect should differ so widely from Ireland or Scandinavia. His views are in happy agreement with those of Dr. Scharff as to the survival of Lusitanian members of our fauna through the alleged destructive epoch of maximum glaciation.

Dr. R. F. Scharff (Proc. Royal Irish Academy, vol. xxviii., sect. B, No. 1, price 1s.) writes on "The Evidences of a Former Land-bridge between Northern Europe and North America." His paper has a special bearing on the origin of the present flora and fauna of Ireland. The author holds that land-bridges afford the only means by which terrestrial species are permanently transferred to a new habitat. He makes out a good case for the existence of a connection between our islands and America in late Pliocene times, and for the pre-Glacial origin of our flora and fauna. Incidentally, there is much that will interest workers on glacial climate, though the view (p. 5) that "the Glacial period was primarily due to the diversion of oceanic currents" will not explain the simultaneous glaciation of Europe, North America, and the central Andes. The only way out of this difficulty, if we rely on ocean-currents, is to accept, with M. Stanislas Meunier (*Revue des Idées*, September 15, 1910, p. 219), the still more difficult proposition that post-Pliocene glacial phenomena were separated, in various regions, by intervals of several thousands of years.

The Transactions of the Hull Geological Society for 1906–9 (1910, price 2s. 6d.) show how local observation may be aptly stimulated. Mr. Sheppard most usefully summarises, with numerous illustrations, recent publications bearing on the district. Mr. F. M. Burton has issued a paper on "The Witham and the Ancaster 'Gap'" as a separate publication (London and Hull: Brown and Sons, price 1s.). Surely this would have found better circulation through one of the northern scientific journals. Something seems omitted in a critical passage on p. 12, where the "clays of the Upper Lias and beds of Marlstone" are said to have extended eastwards, "cutting through the Lower Oolite at Ancaster, and forming the 'Gap' there."

In the Quarterly Journal of the Geological Society of London, vol. lxvi., part iii., issued in August, 1910, Mr. L. Moysey discusses (p. 329) Brongniart's genus Palæoxyris, as abundantly revealed in the Derbyshire and Nottinghamshire coalfield. The similarly problematic organisms Vetacapsula and Favolia are also found, the former being known only from England. All three genera are believed by the author to be egg-cases of fishes. The society, as is well known, publishes abstracts of the discussions on its papers, a practice that should be universally followed under careful editing. We gather that the types of fish that would produce such egg-cases are practically absent from the beds where the three genera are found, and that botanists may still rise up to claim these quaint elongated bodies.

Miss H. Drew and Miss T. Slater (*ibid.*, p. 402) describe the "Geology of the District around Llansawel (Carmarthenshire)," where little has been done since Sedgwick wrote in 1854. The beds described are Gotlandian, and include the whole Birkhill series, followed by Lower Gala beds.

Mr. T. O. Bosworth's work on the metamorphism round the Ross of Mull granite is referred to in the Summary of Progress of the Geological Survey for 1909. He now (Quart. Journ. Geol. Soc., 1910, p. 376) describes the beautiful phenomena of injection of granite along the foliation-flexures and other planes of weakness in the surrounding garnetiferous mica-schists. The latter belong to the Moine series of the Highlands. Groups of well-bounded prisms of sillimanite occur as contact-products in the schists, in addition to the ordinary fibrolitic type. There are some indications in the long and interesting discussion that the views of many Continental observers as to the potency of metamorphism by injection are spreading among workers in the British Isles.

Mr. G. W. Tyrrell, of Glasgow University, has published several papers on the characters of igneous rocks in southern Scotland. Writing on the "Intrusions of the Kilsyth-Croy District, Dumbartonshire" (*Geological Magazine*, 1909, pp. 299 and 359), he points out that the feeders of the laccolite of diabase in this district "appear to cut" the Linlithgowshire intrusive rocks, which have been regarded as of Cainozoic age. Since there is much evidence that the Kilsyth Croy rocks are of post-Carboniferous, but still Palæozoic, date, the Linlithgowshire series to the south must also be late Palæozoic. Micropegmatite veins occur through the diabases, and give cause for an interesting discussion (p. 362) as to their origin in

this and other cases, based on the suggestion of Daly that igneous magmas are essentially basic at the outset. In a paper on "The Classification of the Post-Carboniferous Intrusive Igneous Rocks of the West of Scotland" (Transactions of the Geol. Soc. of Glasgow, vol. xiii., p. 298), Mr. Tyrrell gives a useful account of the distribution of the various types. In cooperation with Mr. N. Martin, he describes the geology of the Auchineden district in the Kilpatrick Hills (*ibid.*, p. 322), and continues (p. 337) with an account of the igneous rocks of the vents and lava-flows. These prove to be olivine-basalts, though the sills were previously thought to be trachytic, on account of their fluidal structure and pale crusts. They belong to the late Palæozoic series. In a notice of rocks near Ballantrae (*ibid.*, p. 283), Mr. Tyrrell points to a granulitic diorite as a dolerite or gabbro metamorphosed by a later intrusion of serpentine. There is a pleasing sense of original outlook in these papers.

The Geological Survey of Ireland has issued a memoir by Messrs. Kilroe, Hallissy, and Seymour on the soils of the agricultural station at Ballyhaise (price 1*s.* 6*d.*), accompanied by a map showing types of soil and the underlying rocks, on the scale of eight inches to one mile. The methods adopted by this Survey for the examination of soils are fully stated. Another memoir, by Messrs. G. A. J. Cole and T. Crook (price 1*s.* 6*d.*), describes the submarine geology of the west coast of Ireland, so far as it can be known from the numerous rock-specimens dredged up by the official Fishery Survey. The amount of mingling of material by glacial drift-action appears to be very small on the west coast. Areas of Upper Cretaceous and Cainozoic limestone are indicated off the Kerry coast. As in the Ballyhaise memoir, a coloured map is included in the publication.

Prof. Cole describes (Proc. R. Irish Acad., vol. xxviii., sect. B, 1910, p. 113, price 6*d.*) the phenomena of weathering on the surface of a sheet of fine-grained diorite near Rathmullan, in Donegal, which is known as the "picture rock" or "scribed rock." The residual spheroids lie in box-like enclosures, the walls of which result from the toughening of the rock by the development of amphibole inward from its joint-planes.

In the *Irish Naturalist* for September, 1910, the Rosapenna area in northern Donegal is systematically described. Among the papers on its natural history is an excellent one on the geological structure, by Mr. J. de W. Hinch.

G. A. J. C.

RUSSIAN MAGNETIC OBSERVATIONS.

UNDER the title "Die Variationen des Erdmagnetismus" Prof. Ernst Leyst has written a paper, occupying 250 pages and four plates, in the *Bulletin de la Société Impériale des Naturalistes de Moscou* for 1909. It deals with magnetic data from the Russian observatories at Pavlovsk (St. Petersburg), Irkutsk, and Katharinenburg, and with some corresponding data from Potsdam and Greenwich. The paper contains valuable statistical data for Pavlovsk, such as the secular changes of all the magnetic elements from 1873 to 1906, and diurnal inequalities derived from a 33-year period. Its main object, however, is to investigate the relations borne to terrestrial magnetism by sun-spot frequency and barometric pressure. A number of the data bearing on the sun-spot connection should be useful, such as diurnal inequalities in years of sun-spot maximum and minimum at the several stations. But their utility would have been greater if the numerical relationships between magnetic and solar phenomena had been gone into more critically. A good deal has been already done on these lines, even for some of the stations considered by Dr. Leyst, of which he seems unaware.

The parts of the memoir having a chief claim to novelty relate to the influence of sun-spot frequency on secular change and on the annual inequality, and to the relation between barometric pressure and the diurnal variations. Dr. Leyst finds secular change of declination to be more rapid near sun-spot maximum than near sun-spot minimum at all the stations included in his research except Katharinenburg. For the ratio borne by the rate of secular change at sun-spot maximum to that at sun-spot minimum he finds nearly 2 : 1 at Greenwich and more than 3 : 1 at Irkutsk. In the case of the annual inequality—*i.e.* the variation shown in the mean monthly values after elimination of the secular change—he concludes in pp. 206–7 that the range is increased at sun-spot maximum for declination and inclination, but diminished for total force. As regards barometric pressure, Dr. Leyst finds the range of the magnetic daily oscillations, both regular and irregular, at Pavlovsk to be larger on days of highest barometric pressure than on those of lowest pressure, the phenomenon being specially conspicuous near sun-spot maximum.

The author's zeal, as evidenced by the great amount of labour expended in his investigations, merits warm appreciation. One's confidence, however, in his conclusions would have been greater if the work had shown more distinct evidence of critical insight.

Lines of no secular change seem to traverse continents with continuous velocity. Their passage must occur at some stations in sun-spot maximum, and at others in sun-spot minimum, and must mark in either case a time when secular change numerically considered is a minimum. In short, secular change, while seldom varying rapidly with the geographical coordinates, is essentially a local phenomenon, whereas sun-spot frequency is not. The secular change results assigned by Dr. Leyst to Greenwich are certainly not fairly representative of sun-spot maximum and minimum there. They show not the least resemblance to some which the present writer has deduced for Kew from the longer period 1860–1909. If a difference of the kind supposed by Dr. Leyst does exist, it is in England, at least, of a comparatively trifling character. As to the annual inequality, that of declination—the element which ought to possess least uncertainty—presents the suspicious features that the ranges obtained have usually diminished as the number of years included was lengthened, while the types obtained at comparatively near stations have differed. In Dr. Leyst's case the results are derived from only two or three groups of three-year periods at either sun-spot maximum or sun-spot minimum, so that more than usual uncertainty attaches to the elimination of the secular change. Of all Dr. Leyst's conclusions, that as to the relations between the diurnal variations and the barometric pressure is undoubtedly the most remarkable. The figures which he gives for declination and horizontal force show during summer, not a small, but a large difference between the ranges of the diurnal inequality and the absolute ranges (absolute maximum less absolute minimum) on days of highest and on days of lowest barometer at Pavlovsk. In winter the phenomenon is much less apparent, which leads the author to regard the case as one of association and not of direct cause and effect.

If confirmed, the result, it need hardly be said, would be of great theoretical importance. A matured opinion on the question could be attained only by a minute study of observational data. Thus an independent investigation of data from some second observatory by a competent critic is to be desired. Several theoretical considerations naturally present themselves. Large absolute magnetic ranges are intimately associated with highly disturbed conditions, and such conditions are normally, at least, not local. High or low barometric pressure, on the other hand, is an essentially local phenomenon. A high at St. Petersburg means a low somewhere else, often even within the confines of Europe. If there is any such general association as Dr. Leyst supposes, a high barometer at Pavlovsk must be a symptom of a special set of conditions affecting an area much larger than that the barometric pressure of which is above the average.

C. CHREE.

THE MICHAEL SARS NORTH ATLANTIC DEEP-SEA EXPEDITION, 1910.[1]

IN August, 1910, Sir John Murray offered to defray the expenses of an expedition to the North Atlantic with the Norwegian research steamer *Michael Sars*. The Norwegian Government, too, showed itself very indulgent towards the enterprise, and placed the vessel entirely at our disposition; and my colleagues, who have so long

[1] From a paper read before the Royal Geographical Society on January 16 by Dr. Johan Hjort.

taken part in these researches, Prof. H. H. Gran, Dr. Helland-Hansen, Mr. E. Koefoed, and Captain Thor Iversen, all signified their utmost willingness to join the expedition.

On completing our preparations, we started off from Plymouth in the beginning of April, 1910, after being joined by Sir John Murray at that port.

During the four months that the cruise lasted, a great deal was accomplished. For oceanographic science it cannot but be interesting to learn that a little steamer, of only 226 tons, could carry out so many and such multifarious researches right across one of the mighty oceans, and I will accordingly give a few figures to illustrate what was done.

In the case of hydrographical material, we collected 2400 water-samples, more than 900 of which were from below the surface. At 110 stations we took 937 temperature observations from below the surface, while as many as 1625 observations of the surface temperature were recorded during the cruise. In addition, we obtained 258 measurements of currents and seven measurements of light. For the study of vegetable plankton we made 140 vertical hauls, and took 38 water-samples for filtering and 58 samples for examining with the centrifuge. For the larger plankton there were 95 vertical hauls with nets of different sizes, 193 horizontal hauls with silk nets, 80 horizontal hauls with pelagic trawls, and 18 hauls with a very large tow-net. Trawlings were undertaken on twenty-four occasions at different depths.

Our being able to carry out so many investigations, in spite of the fact that the ship traversed a distance of about 11,000 miles during the four months the cruise lasted, shows that oceanographic expeditions can be undertaken in small craft and for a relatively moderate expenditure; and this will most likely be a matter for consideration when future expeditions are planned.

Hydrographical Investigations.

At 110 stations we collected material for determining the temperature and salinity of the sea water. The temperature observations have now been corrected, the water-samples have been titrated, and the results are set down in vertical sections and charts showing the distribution of temperatures and salinities at the different depths. The distribution of temperatures and salinities in the sea between Newfoundland and Ireland in the month of July, 1910, can be shown in a diagram. Throughout nearly the whole section there is a layer with salinities of 35·5 per mille in the uppermost 150–200 metres. Both salinities and temperatures decrease in fairly regular proportion as we descend, until we reach a uniform layer termed "bottom water," in which the temperature is slightly below 2½° C., and the salinity is about 34·9 per mille. It is noteworthy that this salinity is exactly the same as has been found in the bottom water of the Norwegian sea during the previous investigations. During the cruise of the *Michael Sars* in the Atlantic, this same salinity has been discovered both between the Canary Islands and the Azores, and between the Azores and Newfoundland, and also outside the Bay of Biscay.

This uniform bottom water lies deeper in the eastern portion of the North Atlantic, off the south coast of Europe and the north coast of Africa, than in the western or north-western portion of the coast of America. East of Newfoundland it attains a comparatively high level. This would seem to indicate that the bottom water of the North Atlantic comes from the north-western portion of that ocean.

A chart shows clearly the influence of the Mediterranean; very salt and comparatively warm water streams out of the Mediterranean and sinks deeper down; outside Spain it mainly flows northwards, owing to the effect of the earth's rotation; another portion seems to follow the ordinary stream towards the south-west. Between the comparatively fresh cold water in the north-west and the relatively warm salt water outside Spain a belt extends from west of the Azores as far as the Faröes and Iceland, with fairly uniform salinities of 35 to 35·5 per mille, and temperatures of 6° to 8° C.

When we compare our temperatures with those of the *Challenger*, we find that they agree most satisfactorily, so far as the deep layers are concerned, and the temperature observations of the *Challenger* seem to have been very good. When we look at all the stations from the cruise of the *Challenger* in the summer of 1873, which are situated in the neighbourhood of the *Michael Sars'* stations of a summer thirty-seven years later, we find everywhere that the water in the mid-layers was much warmer in 1873 than in 1910. The differences of temperature go up to about 5° in the mid water-layers, but sink to 0·1° and 0·4°, respectively, in deep water. This seems to indicate that there are such very great fluctuations from year to year in the degree of warmth in these mid-layers that they even exceed the fluctuations in the seasons.

It is obvious that fluctuations of this kind in the degree of warmth of the Atlantic Ocean are most important, and need further investigation. In the Norwegian Sea such fluctuations in water flowing in from the Atlantic have been already previously investigated by the *Michael Sars*.

These determinations of the temperatures and salinities of salt water will subsequently be utilised for dynamic calculations. It will thus be possible to draw conclusions as to the movements of the different water-layers. These movements the expedition endeavoured also to investigate by means of direct-current measurements with the propeller current-meter which Ekman has constructed.

In the Strait of Gibraltar we tried first to anchor one of the lifeboats fore and aft, as had often been done previously in Norwegian waters. However, the strong current broke the lines repeatedly. We accordingly anchored the ship itself, with 1½-inch steel wire and a warp anchor, in about 200 fathoms. The ship lay thus on April 30 from 2.30 a.m. until 5 p.m. During this time we took seventy measurements at eight different depths.

A comparison of diagrams representing the conditions at 9 a.m., when the inflow into the Mediterranean was at its height, and at 2 o'clock in the morning and 3 o'clock in the afternoon, shows that the effects of the tidal water are very great throughout the whole mass of water from the surface to the bottom. During the inflow, the velocity in the upper instreaming layer was about 1 metre per second, while in the lowest west-flowing layer it did not exceed one-third metre. During the outflow from the Mediterranean to the Atlantic there was hardly any surface current, whereas the outward current at depth had a velocity of up to 2 metres per second. The real velocities were actually greater, as the current generally ran in a slightly oblique direction to the axis of the strait.

During our experiments with the large otter trawl on the bank south of the Azores on June 12, our trawl stuck fast on the bottom. Instead of immediately getting it clear, this otherwise unfortunate circumstance was made use of for taking current measurements. The ship was thus anchored to the trawl at a depth of 668 fathoms (1235 metres). In all, we took ninety measurements at various depths down to 800 metres. On a diagram showing the current from hour to hour at a depth of 10 metres, the tidal movements can be distinctly seen. The actual main current ran southwards with a velocity of 8–9 cm. per second. Another diagram shows the currents in the different layers at three intervals of time:—(1) at 3.30 a.m.; (2) at 7 a.m.; (3) at 10.45 a.m. A comparison of the three figures shows that at all the depths down so far as 800 metres there were tidal movements. On the whole, the currents in the deeper layers flowed in a contrary direction to the movements in the upper ones. There was an astonishingly strong current at 800 metres at 3.30 a.m., but otherwise we found, as a rule, that the current was strongest close to the surface, while at 100 metres there was a tendency to a minimum, and a tendency to a maximum at 200 metres.

The measurements show, accordingly, that there can be very considerable tidal currents even down so low as 800 metres. The reason why they were so strong south of the Azores is probably to a great extent that the bottom there forms a large shoal, which the water presses up against.

Similar investigations with modern methods have never been undertaken before either in deep water or in the Strait of Gibraltar.

That there are tidal movements in the open sea and such strong currents, even at depths above 400 fathoms (800 metres), is interesting for many reasons, as it assists us in understanding the ocean currents, the tide-wave, the

distribution of living organisms, and the deposits along the bottom of the sea.

It has long been a puzzle to find that at great depths in the sea there are stones which are not covered by deposits, though they must undoubtedly have lain at the bottom for a long period of time. On the slopes of the coast banks south-west of Ireland, we shot our trawl in about 1000 fathoms (1797 metres), and found, *inter alia*, numbers of stones.

Sir John Murray has given them to Dr. Peach for examination. As mentioned in Sir John Murray's lecture to the Royal Geographical Society in Edinburgh on November 11, 1910, Dr. Peach "reports that fully 20 per cent. are glaciated fragments. They consist of granite, gneiss, shales, sandstones, chalks, limestones, and flints, and some of these contain fossil remains. The condition of these fragments shows that in many instances they projected above the surface of the deposit in which they were embedded. Dr. Peach has no doubt that these stones were carried by ice during the later phases of the Glacial period to the position in which they were found. They almost all belong to the series of sedimentary, metamorphosed, and erupted rocks now found *in situ* in this country and in Ireland. But the interesting question is, Why have these fragments not been completely covered up by the shells which are continually falling from the surface? Telegraph engineers give reasons for believing that in some localities and depths the rate of accumulation is at least 1 inch in ten years; at this rate all rock fragments deposited during the Glacial period should have been buried in the ooze far beyond the reach of the trawl. Most probably the tidal currents, which our observations showed to exist in deep water, extend right down to the bottom and remove the small Globigerina shells from any ridges. Still, there may be other explanations of the facts" (*Scottish Geographical Magazine*, December, 1910).

Phytoplankton.

The phytoplankton of the Atlantic Ocean, in so far as it can be collected with tow-nets, we know from Hensen's expedition in 1889, the results of which, by the way, have not yet been fully treated; further, from the extensive researches of Cleve. We have also received a valuable contribution from G. Murray and Whitting; the *Valdivia* expedition, carried out by the greater part of its investigations in the Antarctic and Indian Oceans, the researches in the Atlantic being comparatively few. Our knowledge regarding the distribution of species in the Atlantic is, notwithstanding, still very incomplete.

The samples taken by tow-nets in the open sea could not, any of them, compare in quantity with what can be obtained in the coastal waters in the Norwegian Sea. The only exceptions are the series taken to the west of Ireland and in the Bay of Biscay during April (stations 2, 3, 4, 7, 9, 10), where we met with large quantities of diatoms, even down to depths of more than 100 metres.

The oceanic samples are, however, very rich in species, there being, as a rule, at least fifty species in every single sample from the upper layers down to a depth of 100 metres. Many of the species are so sparsely represented that it has only been possible to find a few individuals, but the majority of them have, in spite of their scanty numbers, a wide distribution throughout the warm seas, and they have also been found in the Indian Ocean (*Valdivia*) and the Pacific (Kofoid). A few of them have not yet been described, though most of them are known from previous investigations. It will be a difficult matter to characterise the groups of species according to their geographical distribution within the area investigated; it can perhaps be done when our material has been fully treated, but certainly not as yet. All we can do at present is to distinguish the subtropical species from those which belong to temperate waters, and the oceanic species from the ones which have their centre of distribution along the coasts.

[The lecturer mentioned some instances of the occurrence of interesting forms belonging to the most important plankton-algæ, and then described more particularly the most important botanical discovery of the expedition, that by centrifuging the sea-water large numbers of very small algæ, mostly Coccolithophoridæ, were found. These go through the meshes of the tow-nets, and have therefore not been considered by previous expeditions which only used tow-nets, notwithstanding that Sir John Murray, during the *Challenger* expedition, had directed attention to their importance.]

To sum up, the chief results are as follows:—

(1) The quantity of plankton in the open Atlantic is far less abundant than what is found in coastal seas.

(2) At most of the stations where investigations took place, the maximum of plant-substance was found at about 50 metres' depth; it was, as a rule, scanty in the immediate neighbourhood of the surface, but appeared to be almost as abundant at 10 metres as at 50 metres. There was thus about the same quantity of plants all the way down from 10 metres to 50 metres.

At 75 metres the quantity was, as a rule, not more than half what we met with at 50 metres, and at 100 metres there was only about a tenth part.

This was the case with oceanic water. Where there was an admixture of coastal water, and an evident distinction between the surface layer at depth, the surface layer was comparatively richer in plants, and all the limits had an upward tendency.

(3) The different species are distributed, each in its own characteristic fashion, in regard to depth. The Peridinea keep comparatively near the surface, the diatoms prefer the deepest layers, while the Coccolithophoridæ affect an intermediate position.

(4) The number of living plant cells in the open Atlantic throughout the most densely populated water-layers (10–50 metres) varies, as a rule, between 3000 and 12,000 cells per litre sea water. Of these, about half are Coccolithophoridæ, the rest being Peridinea cells with a few naked flagellates and a sprinkling of diatoms.

THE LARGER ORGANISMS.

Deep-sea Fishes and Crustaceans.

Since the *Challenger* expedition laid the first foundation of our knowledge regarding the animal world of the deep sea, many succeeding expeditions have bountifully added to our store. As an instance, I may mention that we now know one thousand different species of deep-sea fishes and that the German *Valdivia* expedition alone discovered no fewer than sixty-three new species.

Regarding these many species, however, only very little is known. In the case of quite a number of them we are acquainted merely with one, or at most a few specimens while we are in almost complete ignorance as to their biology, their propagation, development history, growth and outward conditions of life.

The view which generally prevails in literature nowadays is that the sea contains a motley abundance of forms either along its bottom or floating within its waters subject to a uniformity of outward conditions of existence —that is to say, passing their lives in absolute darkness—and in a medium with constant temperatures and other physical surroundings.

To biologists, this view concerning the animal life of the deep sea has presented many difficulties. How is that in a constant medium of the kind conceived there exist side by side so many distinct forms? And how again, can animals with large eyes manage to live alongside blind forms? Why are some species furnished with numerous highly developed light-organs, while in the case of others these are entirely wanting? And how, too comes it that within the same groups of animals, nay often in closely affinitive species, the colours vary so remarkably, although the outer medium is the same?

These questions have become all the more pressing now that biological ocean research has discovered instances where in the same area of the sea there occur many different animal forms, each possessed of its own peculiarities in mode of life, habitat, and other respects, so that each species has its own characteristic area of distribution, even though it may occasionally be found together with its neighbours in the same catch. Our study of the spawning-grounds of the cod family (Gadidæ) in the North Sea and Norwegian Sea has shown us, for instance that each of seventeen species has its particular spawning area, each species during the spawning period seeking out distinct characteristic depths, temperatures, and salinities

so that, just as from a morphological point of view the species may be characterised by a definite form or structure, so, too, it is possible to characterise it by certain well-defined conditions of existence. These conditions characterise a given species quite as much as any morphological description, and, in fact, for a proper conception of the species both methods of investigation are supplementary.

Now, if we wish to investigate the conditions of existence under which animals live, we must naturally first of all ascertain where they live, which, in the sea, will be tantamount to discovering the depth where they reside. This alone can enlighten us regarding the conditions of light, the temperatures, and the salinities which are requisite for their existence.

Our knowledge regarding the haunts of the smaller organisms has advanced greatly in recent years owing to the fact that we have made use of small closing nets. But, with regard to the larger animals, especially fishes, we still possess little knowledge, despite the great exertions made in this direction, above all others, by the Prince of Monaco and the *Valdivia* expedition.

When fitting out the *Michael Sars* expedition, I kept ever in mind that one of the most important of all our aims should be to try and develop a method which would yield more information regarding the vertical distribution of deep-sea fishes.

The ideal instrument for capturing the larger pelagic organisms would be a big tow-net or pelagic trawl which could be sunk closed to the requisite depth, then opened and towed at a carefully ascertained depth, and finally closed again and hauled in. Such an instrument would be capable of capturing many of the larger animals, and it would secure them, too, at known depths. However, an instrument of this kind would naturally be extremely complicated, too much so, in fact, to prove trustworthy under our present system of working, and it would further entail a great expenditure of time. It would not be possible to operate many of these tow-nets simultaneously (amongst other reasons, because of the slip-leads), and consequently it would be necessary to undertake a series of hauls at the different depths.

This being the case, I gave up the idea of trying to construct any such instrument. A more practical plan seemed to be to try and tow a number of instruments simultaneously at different depths, and to compare the catches thus made with each other.

Thanks to a practical arrangement, we succeeded in towing ten different instruments from two wire lines. The arrangement generally adopted was as follows:—

At the surface	1 silk net of 1 metre diameter
,, 50 metres... ...	1 ,, ,, ,,
,, 100 ,, ...	1 ,, ,, ,,
,, 150 ,, ...	1 young-fish trawl
,, 300 ,, ...	1 silk net of $\frac{3}{4}$ metres diameter
,, 500 ,, ...	1 young-fish trawl
,, 750 ,, ...	1 silk net of $\frac{3}{4}$ metres diameter
,, 1000 ,, ...	1 young-fish trawl
,, 1250 ,, ...	1 silk net of $\frac{3}{4}$ metres diameter
,, 1500 ,, ...	1 large tow-net of 3 metres diameter (made of shrimp-net) or a young-fish trawl

With this, or a corresponding arrangement, we carried out some long hauls at about thirty stations, as well as from the Canary Islands to the Sargasso Sea, and from Newfoundland to Ireland. Some hauls were made in the daytime and others at night.

In this manner we collected a very large material, consisting of many kinds of pelagic organisms—fishes, cephalopods, crustaceans, medusæ, &c. I will here merely mention a few instances of the evidences our material affords as to the occurrence of these animals at different depths. To illustrate the method employed, I will begin with the remarkable and well-known Sternoptychid *Argyropelecus hemigymnus*. Of this species we caught 286 individuals at the different stations. The bulk occurred at depths between 150 and 500 metres; no individuals were caught above 150 metres, and only about 7 per cent. were taken at depths lower than 500 metres. If we assume, then, that these 7 per cent. were captured during the process of hauling in the appliances, and that none of them live at depths below 500 metres, we will have an idea of the accuracy of our method. By far the greater part were caught at a depth of 300 metres, where we generally had out a $\frac{3}{4}$-metre silk net, whereas at 150 metres and at 500 metres the appliance used was, as a rule, a young-fish trawl, that would have had a far greater capacity for catching these fish. It seems, accordingly, that the preponderating majority of the individuals of this species is very strictly limited to an "intermediary" layer, situated at a depth of about 300 metres. A closer investigation of the individuals captured at a depth of 150 metres shows that they were all caught at night. This may be due either to an upward nocturnal wandering or to chance, though on this question the smallness of our material makes it unsafe to hazard an opinion; in subsequent investigations, however, it will be worth while taking this fact into consideration. Among the individuals captured in 500-metres water there must, at any rate, be a few that were taken in the process of hauling in the young-fish trawl through the intermediary layer above; still, there were far fewer found in the young-fish trawl, which was towed in 1000-metres water—it seems evident that there must also have been some individuals swimming at the 500-metres depth.

This instance gives us a good illustration of our method, with its deficiencies and advantages. It is obvious that the greater the number of individuals we have to deal with, the greater is the probability of obtaining trustworthy information, and the safer are the conclusions we can deduce from our results. When, therefore, in what follows, I proceed to give some instances of the distribution in depth of different kinds of fish, I will begin by mentioning the commonest, or, at any rate, the most numerously captured forms belonging to the species *Cyclothone microdon* and *C. signata*.

Of these two species we caught altogether more than 7500 individuals, which were all measured and arranged according to their length and the instrument in which they were captured, so as also to obtain information regarding the occurrence of the different sizes at different depths.

C. microdon was found during the cruise of the *Michael Sars* in the northern Atlantic at every station where an appliance was towed in depth below 500 metres. Above 500 metres it was only met with occasionally. A table shows how, at a depth of 300 metres, we only came across one individual (in the southern section). In depths from 500 metres down to 1500 metres its quantitative occurrence appears to be fairly uniform.

In our northern as well as in our southern section we found approximately the same number of individuals in each of the three young-fish trawls, which we towed simultaneously, viz. at depths of 500 metres, 1000 metres, and 1500 metres.

When we next examine the size-distribution at the different depths, we see that it is perfectly clear that the smaller sizes are met with much higher up than the larger ones, which latter are mainly to be found at a depth of 1500 metres. In the northern section we find that at a depth of 500 metres the greatest number of individuals were 30 mm. in length, whereas at 1500 metres the majority were 60 mm. At a depth of 500 metres we only came across two that were more than 50 mm. in length.

The smaller and younger individuals, of a length of 20–30 mm., live, accordingly, to a preponderating extent, 1000 metres higher up in the water-layers than the majority of the largest and oldest individuals.

Another remarkable fact which strikes us when we study the table is that the average size of individuals is much smaller at the same depth in the southern than in the northern section.

C. signata resides in an intermediary layer, with maximum in the number of individuals at about 500 metres. In the case of this species, too, we note that the younger individuals are mainly to be found high up in the water (notice particularly the southern stations), and that the same size is to be found deeper in the southern section than in the northern.

We have a remarkable parallel to the areas of vertical distribution of these two fish species in the case of the red-prawn species. These latter unite with the black fishes in forming a populous and characteristic "com-

munity." We have come across no fewer than twenty-six species of prawns, of which we shall here refer to *Acanthephyra multispina* and *A. purpurea*.

A. multispina shared with Cyclothone the peculiarity of the largest and oldest individuals, being found in the nets towed at greatest depths, say at 1000–1500 metres. *A. purpurea* resembles *Cyclothone signata* in that its distribution is chiefly confined to an intermediary layer between 500 metres and 750 metres in depth.

The instances I have given show the utility and exactness of our method of working. Where we have to deal with catches of great numbers of individuals, our errors and inaccuracies will undoubtedly be very small. The catches which the *Michael Sars* made of such forms as Cyclothone and Acanthephyra were certainly most satisfactory in this respect. But when we come to the catches which the expedition made of scarce forms, or forms more difficult to capture, then we are bound to own that the method of working even of the *Michael Sars* is not sufficiently effective. Still, it is interesting to examine a few of the results yielded by the method we employed with the object of discovering some conformity, or some general rule, for the peculiar distribution of the different organisms at different depths.

I will commence with the view I formed during the cruise itself from the appearance of the catches on board, which view I find has also, to a certain extent, forced itself upon other observers, chief amongst whom I may mention Prof. A. Brauer, to whom was confided the treatment of the fishes of the *Valdivia* expedition. I found on examining the catches from great depths that the black and dark-red forms were the all prevailing ones among animals from the greatest depths.

Black-coloured pelagic fishes are few in number, though they might be termed numerous if we take into account what was previously known concerning "scarce" forms. *Gastrostomus bairdii*, Cyemaatrum, and *Gonostoma grande* were only caught at depths from 750 metres downwards. The two species *Gonostoma elongatum* and *Ptotostomias guernei* were caught at great as well as small depths, even in some cases so high up as 150 metres below the surface. The rule, then, that the black forms are only to be found at great depths, cannot be said to hold good universally.

The question accordingly arises whether among the black forms there may not be said to be groups or different types. In common with several previous observers, I have been struck by the fact that even the anatomical structure of the black fishes points to different modes of living. When we compare, for instance, pictures of the above-mentioned five species of fish, we see that, of the three species which were only found at great depths, *Gastrostomus bairdii* and Cyemaatrum are quite without light organs, and *Gonostroma grande* has but small ones, as is also the case with *Cythotlone microdon*. In *Gonostoma elongatum* and *Ptotostomias guernei*, the light organs are much more developed (as is also the case with *Cyclothone signata*). It is an interesting fact now to notice that every single individual of these two species which was captured higher up than 500 metres was caught at night, which coincides with previous observations regarding black forms, such as Idiacanthus and Astronesthes, which have been caught at night right close up to the surface. We may assume, accordingly, that among the black deep-sea fishes there are several different modes of life, that is to say, several different "biological types."

With the view of a better understanding of the occurrence of these black and red types in the sea, I have endeavoured to compare their vertical distribution with the intensity of the sunlight in different depths and at different parts of the ocean.

We have seen that the upper limit for *Cyclothone microdon* and the red crustaceans in the northern section from Newfoundland to Ireland, or about 50° N. lat., was approximately 500 metres below the surface, and we have also noticed that the limit of depth for the same forms at the southernmost stations, or about 33° N. lat., was some 200–300 metres deeper. In the Norwegian Sea I have already previously investigated the intermediary pelagic fauna, and found pelagic red prawns as well as the dark-red fish *Sebastes norvegicus* at depths of about 200 metres below the surface. Sebastes was taken, for instance, with floating long lines in considerable quantities on a course Jan Mayen-Lofoten—that is to say, in about 67° N. lat., at a depth of 200 metres—and it was even found, though in decreasing quantities, higher up. Along the Norwegian coast, in the fjords and sounds, we have a particularly rich fauna of red crustaceans (especially *Pandalus borealis*) residing at depths the maximum of which in the north, at any rate, may be put at about 200 metres. Now, if we calculate the depth to which the rays of the sun penetrate, after passing through the same distance in the water, assuming always that the rays are direct, and that the rate of absorption is the same, we find that the rays will have passed through the same distance to reach a depth of 500 metres in 50° N. lat., that they will pass through to reach 650 metres in 33° N. lat., or 300 metres in 67° N. lat.

However, the transparency of the water varies greatly in different regions. If we take the results of previous observations during different expeditions, we may set down the visible depth in the open sea as being, roughly, 50 metres in 33° N. lat., 40 metres in 50° N. lat., and 25 metres at the outside in the Norwegian Sea in 67° N. lat. Taking this into consideration, we find that there will be the same intensity from the retilinear rays

In 33° N. lat.,	at about	800	metres'	depth
,, 50°	,,	500	,,	,,
,, 67°	,,	200	,,	,,

The red and black animal forms, as has been found in the investigations I have just described, have an upper limit in the different waters which corresponds everywhere with the same intensity of light.

During the Atlantic cruise of the *Michael Sars* we undertook a series of measurements of the intensity of light with a photometer constructed by Dr. Helland-Hansen; to determine the intensity of the different colour rays, Dr. Helland-Hansen made use of panchromatic plates and gelatin colour-filters. The observation south and west of the Azores (that is to say, at the southern stations) showed that the rays of light strongly affected the plate at a depth of 100 metres. The red rays were weakest here, while the blue and ultra-violet rays were strongest. At a depth of 500 metres the blue and ultra-violet rays were still distinctly visible, and at a depth of 1000 metres the ultra-violet rays were yet perceptible. In 1700 metres, however, there was not the faintest trace of light, even after the plates had been exposed for two hours in broad daylight.

In the above-mentioned deep, which denotes the upper limit for the black and red forms during the daytime, we may after this, no doubt, assume that there are only to be found chemically effective rays from the violet portion of the spectrum. Now, seeing that the coefficient of absorption for the red rays, as compared with the violet is about in the proportion of 30 to 1, and that our observations failed to trace any red rays at a depth of 500 metres it follows that the red animals at this depth must be quite as invisible as the black ones. It is interesting to note, in this connection, that it is only at night that the black fish with large light organs are found high up in the water, and that red crustaceans in the Arctic regions as was noticed by Scoresby in the case of *Hymerodon glacialis*, are to be found right up to the edge of the ice at the surface of the sea.

Above the region I have hitherto been describing, with its black and red forms, our parallel hauls have shown us an equally characteristic, though very different, group of pelagic fishes. Their peculiarity is that their body always more or less compressed from one side to the other. In colour they are dark along the back and silvery or shining, with a bluish-violet gleam along the sides, the eyes are large and often telescopic, and most characteristic of all, I suppose, are their strongly developed light organs characteristic forms are especially to be met with among the families Sternoptychidæ and Stomiatidæ. From table showing the depth at which a number of these forms occur, it can be seen that 500 metres may be taken as their lower limit, and that the greatest number individuals reside at a depth of 300 metres; above 1[illegible] metres there were only a few found, and even those th[illegible]

were met with in 150 metres, or higher up, were with very few exceptions taken at night.

Cyclothone signata may be said to approximate to this group so far as distribution is concerned, and this form also has large, well-developed light organs. A closer analysis of the occurrence of these forms in different latitudes would probably reveal much of interest, though this must be reserved for subsequent investigations.

It is important to lay stress upon the fact that these shining colours, remarkable light organs, and peculiar telescopic eyes do not belong to the dark region in the sea where the sunlight never penetrates, but, on the contrary, to a region where there are, at any rate, large quantities of the rays which are nearest to the blue, violet, and ultra-violet portion of the spectrum.

There has been a good deal of disputing as to whether the light emitted by the light organs was entirely produced by the vital energy of the organisms, or whether the organisms had the power of transforming the ultra-violet rays of the sunlight into rays of lesser wave-length. The observations I have described here cannot, of course, decide questions of this kind, but they show, at any rate, that the light-emitting organisms live in a medium in which there are quantities of rays from the sunlight; and we recognise, further, in these forms a new biological type of organisms, a separate group with quite characteristic outward conditions of existence.

The higher we ascend towards the surface of the sea, the more varied become the forms and colours of the organisms, and the more diversified become also, probably, their conditions of life. I have up to now only been able to examine a portion of the large material from the uppermost water-layers, and will merely mention a single group from this region, namely, the larvæ and young fish forms. Of these we have collected a very large quantity, amounting to thousands. It has been impossible to determine them all, as this will be a long and laborious task.

A table shows how, out of 3600 transparent large and young fishes, 90 per cent. were secured in the appliances operated from the surface down to a depth of 150 metres. These forms are young stages of many different kinds of fishes.

A very interesting and important question is the quantity of animals in the different depths. This question has not been much studied yet. I believe myself that the upper limit of the red and dark-coloured forms is particularly rich. In the Norwegian Sea I found that the occurrences of a rich intermediate pelagic life corresponded to a great rise in the density of the sea water, and I explained this thus, that the food of the animals, sinking down from the upper layers, might accumulate there. The closer study of our material may give more information about this interesting question.

In my preceding remarks I have given a number of instances of the observations we were able to make regarding the depth distribution of fishes when we examine material collected by means of parallel hauls. But it is obvious, too, that this material can equally well be used for ascertaining their horizontal or geographical distribution, and it is only after studying simultaneously as well their vertical and horizontal distribution that we can characterise the outward conditions under which they live. If we look at the horizontal distribution as found by the *Michael Sars* and compare it with previous observations in the northern Atlantic, we shall get some idea of how little knowledge we possess concerning the most ordinary forms inhabiting the ocean between Europe and the coast of the United States. I will base my comparison entirely on Brauer's valuable summary of what was previously known, and on the same instances that I have employed when discussing the vertical distribution.

Black fishes and red crustaceans were caught at all the stations during the cruise of the *Michael Sars* in the Atlantic wherever we lowered our appliances to a depth of 500 metres.

Transparent young fish were captured over the whole area of investigations, though in very varying quantities.

In the open sea over the greatest depths, the Scopelidæ are undoubtedly the most numerous group among the young fish. We find also many extremely interesting forms with stalk eyes, telescope eyes, and so on. Amongst those with telescope eyes there are many of a perfectly transparent new form, which may in all probability be assigned to the genus Dysomma. They were mostly caught in the uppermost 150 metres.

When we have succeeded in determining these young stages, we will be able to throw much light upon the life-history of many important species of fish. The numerous forms of the group Leptocephalidæ will by no means be the least interesting among them. The 195 individuals that were found are believed to belong to no fewer than twenty species, of which a good many are entirely new.

I have previously (in NATURE of October 24, 1910) published a short description of a number of these Leptocephalidæ, which we were able to prove to be the larvæ of the European eel. These larvæ (forty-four specimens in all) have this much of interest in them as compared with previous finds, that they were met with right out in the Atlantic Ocean, far away from the slopes where they previously had been discovered.

Trawlings.

To operate the big trawl at the greatest depths of the North Atlantic, about 2500 or 3000 fathoms, proved a very difficult task. However, two of our hauls were quite successful. The first was in the Bay of Biscay, at a depth of 2500 fathoms. Our catch contained a number of invertebrates, including holothurians of the genus *Elpidia alcyondae*, sponges, and ascidians, and two fishes belonging to the genus Macrurus.

The second haul, between the Canary Islands and the Azores, at a depth of 3000 fathoms, yielded only a very few living organisms. In the half-barrel of mud brought up by the trawl we found thirty pumice-stones overgrown with Stephanocylis and Limopsis, and there were also two holothurians (*Laetmogone violacea* and Elpidia, sp.), sertulariæ, fragments of an umbellularia, an antipathes, a spike of a cidaris, fragments of shell of argonauta, as well as one Bulla tympanica of a whale, and two shark's teeth, of which the first belonged to a carcharodon and the second to an exyrhina. Of fishes there were one Malacosteus, one Alepocephalus, one Leptocephalus, one Argyropelecus, and a form not yet determined. All these I believe to have been pelagic, and to have been taken during the process of hauling in. Regarding one form alone, there was doubt whether to class it as a bottom fish or as pelagic, namely, an unquestionably new species much resembling *Ipnops murrayi.*

Judging from the appearance of the trawl when being lowered and when being afterwards hauled in, I consider this haul to have been, technically speaking, a success, and I cannot explain the catch otherwise than by supposing that at those profound depths there was an absolute poverty of animal life. It remains a question whether all these great ocean floors are equally barren in regard to animals, and especially fishes. So far as I know, the literature on the subject only records the capture of a few Macruridæ from the greatest ocean deeps, this being all the evidence that there is to favour belief in the occurrence of larger fish there. But is it perfectly certain that even those are not also pelagic? On several occasions during the cruise our tow-nets captured over the greatest ocean depths pelagic specimens of Alepocephalus, which is generally brought up by the trawl. In any case, the animal life there must be extremely scanty; and this is borne out by the vertical hauls with our big net below 1500 metres, which I have referred to when discussing *Cyclothone microdon.*

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The professor of mineralogy has, with the consent of the Vice-Chancellor, reappointed Mr. A. Hutchinson to be demonstrator in mineralogy and assistant curator for five years from January 1.

Dr. Hobson has been appointed chairman of the moderators and examiners for the Mathematical Tripos, Part ii., 1911.

Mr. C. E. Inglis has been appointed chairman of the examiners for the Mechanical Sciences Tripos, 1911.

DURHAM.—Mr. P. J. Heawood, mathematical lecturer, has been appointed to the professorship of mathematics in succession to Prof. R. A. Sampson, F.R.S., who was recently appointed Astronomer Royal of Scotland.

DR. FREDERIC S. LEE has been appointed head of the department of physiology at Columbia University, New York, on the retirement of Prof. J. G. Curtis. He has been connected with the University since 1891, having successively held the posts of demonstrator, adjunct professor, and research professor.

BY the will of the late Mr. W. S. Steel, of Philiphaugh, Selkirkshire, the sum of 5000*l.* is to be set aside for the establishment of "The Strang Steel Fund," the income of which is to be applied for the advancement of education in Selkirkshire, including the burgh of Selkirk. Mr. Steel also bequeathed 5000*l.* to Glasgow University to found a scholarship for promoting research in any department of science the University may consider desirable, and the income of 2000*l.* for the purchase of books for the library of the University.

THE Regent Street Polytechnic, London, is being rebuilt this year at a cost of 90,000*l.* The rebuilding fund was inaugurated by a grant of 20,000*l.* from the London County Council and a loan of 20,000*l.* from the City Parochial Foundation. The 50,000*l.* needed to complete the fund has been subscribed and promised with the exception of 2500*l.*, which has been reserved so that as many old members, scholars, students, &c., of the polytechnic may have the opportunity of participating in the scheme. Donations of 1*l.* to 100*l.* may be sent to the secretary of the polytechnic, 309 Regent Street. Among donations to the rebuilding fund may be mentioned Lord Leith of Fyvie, 30,000*l.*; Mr. Howard Morley, 5000*l.*; and Lord Howard de Walden, 3500*l.*

THE report of the principal of the Huddersfield Technical College, read at the recent distribution of prizes to students of the institution, is a record of steady progress. Not only was there during last session a substantial increase in the number of both day and evening students, but also in the fees paid and the grants received from the Board of Education. In addition to the strictly technical part of the work of the colleges, courses of instruction are provided which enable students to graduate at the University of London. At the conclusion of his report the principal suggested an enlargement of the sphere of usefulness of the institution during the daytime, and consideration is being given to the possibility of expanding the work of the college in the following directions:—the more vigorous conduct and better organisation of the day commercial department; the establishment of day classes for apprentices in various trades; day classes in mining for workers employed on night shifts; trade schools of dressmaking, millinery, or cloth mending; and the opening of a home-making centre, to be worked in conjunction with the department of domestic economy.

AT the convocation of the University of Chicago on December 20, 1910, a letter from Mr. John D. Rockefeller to the president and trustees was read. In the letter, which is printed in *Science* for December 30, Mr. Rockefeller announces that he has had 2,000,000*l.* set aside for the University of Chicago, and that it is to be delivered to the University in ten equal annual instalments, which began on January 1 of this year. Each instalment is to bear income to the University from the date of such delivery only. The letter goes on to point out that Mr. Rockefeller believes that it is better for a university to be supported and enlarged by the gifts of many rather than by those of a single donor, and he states that the University of Chicago has received in addition to his own gifts more than 1,400,000*l.* from citizens of Chicago and the West. With his latest generous gift, Mr. Rockefeller says he has completed the task he set before himself as regards the University; and his letter contains his resignation from the board of trustees, and the announcement of the resignations of his personal representatives. "I am acting," the letter says, "on an early and permanent conviction that this great institution, being the property of the people, should be controlled, conducted, and supported by the people in whose generous efforts for its upbuilding I have been permitted simply to cooperate." A resolution of appreciation of Mr. Rockefeller's generosity, adopted by the trustees, states that altogether the sums received from him amount to 7,000,000*l.* The trustees, too, are able to say in their resolution:—"Mr. Rockefeller has never permitted the University to bear his name, and consented to be called its founder only at the urgent request of the board of trustees. He has never suggested the appointment or removal of any professor. Whatever views may have been expressed by members of the faculty, he has never indicated either assent or dissent. He has never interfered directly or indirectly with that freedom of opinion and expression which is the vital breath of a university, but has adhered without deviation to the principle that while it is important that university professors in their conclusions be correct, it is more important that in their teaching they be free."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 12.—Sir A. Geikie, K.C.B., president, in the chair.—Prof. H. L. **Callendar** and H. **Moss**: The absolute expansion of mercury.—Dr. R. W. **Gray** and Sir W. **Ramsay**: The density of niton (radium emanation) and the disintegration theory.—Prof. J. S. **Townsend**: The charges on ions in gases, and some effects that influence the motion of negative ions. The experiments on charges on ions in gases which had previously been made with air only have been extended to oxygen, hydrogen, and carbonic acid. The value of the quantity Ne for the negative ions is in all cases very near the value $1{\cdot}22\times10^{10}$, which corresponds to a charge, e, equal to the charge on a monovalent atom. The ions were produced by secondary Röntgen rays, and it was found that when non-penetrating rays were used the value of Ne for the positive ions was practically the same as for negative ions, but is much larger when the penetrating rays are used, showing that in this case some of the positive ions have double charges. The motion of the negative ions is considerably changed by carefully drying the gases, and the results of the experiments may be used, in conjunction with the determinations of the velocities made by Mr. Lattey, to determine the apparent mass of the negative ion, which diminishes at low pressures as the electric force is increased. For a given force, the pressures at which the effect of drying becomes appreciable is higher in hydrogen than in oxygen, and much less in carbonic acid than in the other gases.—F. W. **Aston**: The distribution of electric force in the Crookes dark space. The method used in the investigation is one due to J. J. Thomson, and consists in shooting a beam of homogeneous kathode rays transversally through the discharge, and observing the deflection of the beam at various points. The results so obtained are free from the very serious objections which may be urged against the "sounding-point" methods used by previous observers. The electric force in the negative glow is found to be negligibly small, while within the Crookes dark space it is satisfied within experimental error by the simple formula $\mu(D-x)$, where D is the length of the dark space, x the distance from the kathode, and μ a constant. This result indicates the presence of a uniform charge of positive electrification within that region. The distribution is the same for all gases, pressures, and currents used. By integrating the forces so obtained, the potential fall across the dark space is calculated, and is found in all cases to agree within experimental error with the actual potential between the electrodes. The large and abrupt fall of potential at the surface of the kathode found by other investigators is probably a result of faulty methods, an explanation of which is suggested.—Dr. P. E. **Shaw**: The measurement of end-standards of length. A continuation of work published in Roy. Soc. Proc. (December 1, 1905). In recent years the authorities at the National Physical Laboratory have been required to measure and test end-standards with unprecedented accuracy. As a result, the faults of the standards and of the measuring machines have come to light. In this

paper an account is given (1) of improvements in the planeness and parallelism of the standards; (2) of changes introduced in the author's measuring machine to cope with the more accurate standards. It is easy to get consistent readings of length provided the standard is not moved; but if, as is required, the standard is moved, it is a difficult mechanical problem to provide a movement so nearly parallel that the readings before and after movement shall be consistent. Curves and tables are given showing the degree of accuracy at present obtained. A great advance in refinement is expected on the present lines of work.

Linnean Society, December 15, 1910.—Dr. D. H. Scott, F.R.S., president, in the chair.—Dr. O. **Stapf**: Report on the International Botanical Congress, held at Brussels on May 14–22, 1910. The Linnean Society appointed five delegates for the congress with the view of having the different departments concerned in the discussion on taxonomic nomenclature so far as possible represented. The delegates were Messrs. Arber (fossil plants), Cotton (algæ, lichens, and fungi), Gepp (Musci and Hepaticæ), Henry Groves and Dr. Stapf (phanerogams and vascular cryptogams, and Mr. H. Groves also Charceæ). Phytogeography was not taken especially into account, as Mr. Tansley, the delegate of the Cambridge Philosophical Society, joined Section iii.—R. W. H. **Row**: Non-calcareous sponges from the Red Sea, collected by Mr. Cyril Crossland. The present report contains descriptions of seventy-seven species, belonging to forty-four genera, of which thirty-one species and four genera are new to science. The total sponge fauna of the Red Sea now includes no fewer than 187 species, but this includes certain forms only found in the Gulf of Aden. The Red Sea sponge fauna shows a very great similarity to that of the Indian Ocean, no fewer than eighty species being found common to the two regions. Of these eighty species, sixteen occur along the coasts of East Africa or on the islands near by, twenty-five occur in Ceylon, and no fewer than thirty-one in the East Indies and Australia. As a result, the Indo-Australian region, as defined in the report on the Monaxonia of the *Challenger* expedition, has been enlarged to include the whole of the Indian Ocean and the adjacent seas, and it is suggested in this report that a division into western and eastern areas can be made along the sixty-fifth meridian of east longitude. The fauna of the Red Sea, not only as regards sponges, but in general also, shows a very close relationship both in character and species with that of East Africa, and that of Ceylon with the Australian fauna. Another interesting feature of Mr. Crossland's collection is the presence of three species previously only known from the Mediterranean area, or, at any rate, the North Atlantic. It is suggested that these forms have migrated thence into the Red Sea through the Suez Canal.—R. S. **Adamson**: Notes on the comparative anatomy of the leaves of certain species of Veronica. Thirty-eight species of the genus, natives of New Zealand, have been examined, which show great variation of form. All are more or less xerophilous and evergreen. One of the most noticeable features is the formation at the leaf-insertion of a patch of cork-cells which completely cuts off the continuity of tissues except for the bundle; these cells are formed by a phellogen, and may appear in the first year of the three during which the leaf persists. The species show, in general, a series of increasingly xerophilous types of leaf structure, from forms with large leaves with normally differentiated mesophyll, through those with quite homogeneous structure, to forms with scale-like leaves with corresponding anatomical modifications. The less xerophilous species have hydathodes at the leaf-apex that may be modified in various ways; these are absent in the more xerophilous forms. Stomata are protected in various ways, especially by cuticular expansions over the pore, and by depression of the guard-cells below the surface. The xerophilous nature of the leaves can be correlated to some extent with the climatic conditions in the native habitats.

Mathematical Society, January 12.—Dr. H. F. Baker, president, in the chair.—T. C. **Lewis**: A property of the number 7.—Prof. E. W. **Hobson**: The fundamental theorem relating to the Fourier constants for given functions.—Prof. H. M. **Macdonald**: The integration of the equations of propagation of electric waves.—Dr. W. H. **Young**: The fundamental theorem in the theory of functions of a complex variable.—Miss H. P. **Hudson**: The 3-3 birational transformation in three dimensions (second paper).

PARIS.

Academy of Sciences, January 9.—M. Armand Gautier in the chair.—Emile **Picard**: A singular integral equation.—A. **Laveran**: The resistance of goats and sheep to trypanosomiases: the long duration of acquired immunity following these diseases. Both sheep and goats are susceptible to most of the trypanosomiases, but the attack is usually slight and followed by cure, whilst in most other animals the termination is fatal. The serum of a sheep two and a half years after cure from an attack of *T. dimorphon* is active, and protects mice against the attack of the same organism. Similar results were obtained from the serum of the goat.—M. **de Forcrand**: Some probable chemical properties of radium and its combinations. From thermochemical data for the metals of the alkalis and the alkaline earths, and the position of radium in this series, thermochemical data are calculated for radium and its compounds. From these data it is reasonable to assume that the hydroxide will be a little more stable than baryta, but a little more easily dissociable than sodium hydroxide; the oxide RaO should be easily converted into the peroxide RaO_2 at a red heat, and radium carbonate should be decomposed with some difficulty at a red heat. The existence of a hydride (RaH_2) is also predicted.—M. **Luizet**: The variable brightness of certain stars of the type of δ Cephei. On the basis of certain assumptions, the changes in brightness are calculated, and the curves thus obtained compared with the experimental data, with satisfactory agreement.—Charles **Nordmann**: The effective diameters of the stars. Starting with the effective star temperatures determined by the author's stellar photometer, the effective diameters of ten stars are calculated. It is found that stars the effective temperature of which are higher than that of the sun have the smallest diameters, the contrary holding for stars cooler than the sun.—M. **Le Fort**: An interpolation formula established with a view to some practical applications.—M. **Ziembinski**: The relation existing between the thrust of a propulsive helix when fixed and when attached to a body in motion in the air.—Pierre **Weiss**: A new property of the magnetic molecule. If the molecule Fe_3O_4 in magnetite possesses four degrees of freedom of rotation, the value of the specific magnetisation at the absolute zero will be 97·7, very near to the value 95·9 obtained by Kamerlingh Onnes at the temperature of liquid hydrogen. From the experiments described, it is found that at certain temperatures the magnetic moment of the molecule increases suddenly by quantities bearing a simple numerical relation to the magnetic moment of the molecule at low temperatures.—L. **Décombe**: The definition of entropy and of temperature. Monocyclic systems.—J. **de Kowalski** and J. **de Dzierzbicki**: The influence of functional groups on the spectrum of progressive phosphorescence. The substances studied were examined in alcoholic solutions (concentration 0·05 normal) at about −190° C. The acids examined included benzoic, the three toluic, three amidobenzoic, three oxybenzoic acids, and also benzonitrile and *p*-tolunitrile.—Witold **Broniewski**: The electrical properties of the aluminium-magnesium alloys. The experiments included measurements of the electrical resistance, thermo-electric power (against lead), and the variation of the thermo-electric power with temperature, the data obtained being given in the form of curves with the percentage of magnesium as abscissæ. The probable existence of the compounds AlMg and Al_3Mg_4 is indicated, but the existence of Al_4Mg and $AlMg_2$, described by earlier workers on the same subject, could not be confirmed.—Ed. **Chauvenet**: A general method for the preparation of anhydrous chlorides (see p. 383).—J. B. **Senderens**: Ketones derived from the three isomeric toluic acids. The method for preparing ketones, based on the catalytic action of thoria, described by the author in a previous paper, has been applied to the preparation of fifteen cresyl-alkyl-ketones. The density, boiling point, and melting point of the semicarbazone are given for each ketone.—M.

Lanfry: A new thiophene compound, $C_{10}H_6S_2$, and some of its derivatives. The new compound was isolated from the products of the reaction of sulphur and naphthalene vapour when passed through an iron tube at a red heat. Its composition is probably either phenothiophene or phenodithiophene. An account is given of the behaviour of the new compound on oxidation.—A. **Wahl**: The condensation of acetic ester with its higher homologues. Contrary to the views held up to the present, the condensation of acetic ester with its homologues by means of sodium is possible in certain cases. Details are given of the preparation of butyrylacetic ester by this reaction.—Jean **Dybowski**: A new source of natural indiarubber. A method of utilising Jeloutong, resulting from the coagulation of the latex of *Dyera costulata*.—L. **Blaringhem**: The rules of Naudin and the laws of Mendel relating to hybrids. The examples described are not in accord with Mendel's laws, but fully agree with the rules given by Naudin in 1861.—Jules **Laurent**: The physical conditions for the resistance of the vine to mildew.—René **Maire** and Adrien **Tison**: Researches on some Cladochytriaceæ.—P. **Chausé** and L. **Pissot**: The process of caseification in human tuberculosis.—Ch. **Janet**: The existence of a chordotonal organ and of a pulsatile antennary vesicule in the bee, and on the morphology of the head of this species.—Alfred **Angot**: The value of the magnetic elements at the Val-Joyeux Observatory on January 1, 1911.—Alfred **Angot**: The earthquake of January 3–4, 1911. The earthquake, the epicentre of which appeared to be in Central Asia, was recorded on the seismograph of the Parc Saint-Maur Observatory, and was the most violent hitherto recorded, the amplitude being outside the range of the recorder for about six minutes. The vibrations of the ground were sufficient to disturb the magnetographs.—Louis **Fabry**: The earthquake of January 3, 1911. Details of the records of the seismograph at the Observatory of Marseilles.—Henri **Bourget**: Remarks on the preceding communication.

CALCUTTA.

Asiatic Society of Bengal, December 7, 1910.—P. C. **Rây** and Jitendra Nath **Rakshit**: Methylamine nitrite. When mercuric nitrite solution is treated with dilute ammonia, a precipitate of dimercurammonium nitrite is formed, and ammonium nitrite remains in solution (Trans., 1902, lxxxi., 644). Recently a solution of mercuric nitrite was similarly treated with dilute methylamine. The precipitate which was thus obtained proved on analysis to be dimercurammonium nitrite, pure and simple. The filtrate, amounting to about 25 c.c., was distilled in a vacuum at temperatures gradually raised from 45° to 50°.—Hem Chandra **Das-Gupta**: The occurrence of Maestrichtien fossils at Kacch Station (in British Baluchistan).

DIARY OF SOCIETIES.

THURSDAY, JANUARY 19.

ROYAL SOCIETY, at 4.30.—The Action of *B. lactis ærogenes* on Glucose and Mannitol. Part II.: G. S. Walpole.—The Pharmacological Action of South African Boxwood (*Gonioma Kamassi*): Dr. W. E. Dixon.—Autoagglutination of Red Blood Cells in Trypanosomiasis: Dr. W. Yorke.—The Transformation of Proteids into Fats during the Ripening of Cheese (Preliminary Communication): M. Nierenstein.—The Action of X-rays on the Developing Chick: J. F. Gaskell.—(1) Experiments to ascertain if Antelope may act as a Reservoir of the Virus of Sleeping Sickness (*Trypanosoma gambiense*); (2) Experiments to ascertain if the Domestic Fowl of Uganda may act as a Reservoir of the Virus of Sleeping Sickness (*Trypanosoma gambiense*): Colonel Sir D. Bruce, F.R.S., and others.

ROYAL INSTITUTION, at 3.—Recent Progress in Astronomy: F. W. Dyson, F.R.S., Astronomer Royal.

LINNEAN SOCIETY, at 8.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Research Meeting. Neolithic Villages in Thessaly: Messrs. Wace and Thompson.

FRIDAY, JANUARY 20.

ROYAL INSTITUTION, at 9.—Chemical and Physical Change at Low Temperatures: Sir James Dewar, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Modern Electrical Dock-equipment, with Special Reference to Electrically-operated Coal-hoists: W. Dixon and G. H. Baxter.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design and Construction of Reinforced-concrete Arches: G. F. Walton.

TUESDAY, JANUARY 24.

ROYAL INSTITUTION, at 3.—Heredity: Prof. F. W. Mott, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Anniversary Meeting.

MINERALOGICAL SOCIETY, at 5.30.—On Kaolin: F. H. Butler.—On Schwartzembergite: Dr. G. F. H. Smith and Dr. G. T. Prior.—An Improved Form of Total Refractometer: A. Hutchinson.—A Case of Electrostatic Separation: T. Crook.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Sand-movements at Newcastle Entrance, N.S.W.: C. W. King.—Fremantle Harbour-works, Western Australia: C. S. R. Palmer.—The Bar Harbours of New South Wales: G. H. Halligan.

WEDNESDAY, JANUARY 25.

ROYAL SOCIETY OF ARTS, at 8.—Motor Transport in Great Britain and the Colonies: H. M. Wyatt.

INSTITUTION OF MINING AND METALLURGY, at 8.—*Adjourned discussion*: Notes on Chilian Mills in Russia: H. C. Bayldon.—Notes on Placer Mining, with Special Reference to Hydraulic Sluicing: N. A. Loggin.

GEOLOGICAL SOCIETY, at 8.—The Skomer Volcanic Series (Pembrokeshire): H. H. Thomas.—Some African Evidence for the Planetismal Hypothesis: E. H. L. Schwarz.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, JANUARY 26.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Memoir on the Theory of the Partitions of Numbers. Part V. Partitions in Two-dimensional Space: Major P. A. MacMahon, F.R.S.—The Origin of Magnetic Storms: Dr. A. Schuster, F.R.S.—On the Fourier Constants of a Function: Dr. W. H. Young, F.R.S.—On the Energy and Distribution of Scattered Röntgen Radiation: J. A. Crowther.—On some new Facts connected with the Motion of Oscillating Water: Mrs. H. Ayrton.

ROYAL INSTITUTION, at 3.—Recent Progress in Astronomy: F. W. Dyson, F.R.S., Astronomer Royal.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Long Distance Transmission of Electrical Energy: W. T. Taylor.—Extra High Pressure Transmission Lines: R. Borlase Matthews and C. T. Wilkinson.

FRIDAY, JANUARY 27.

ROYAL INSTITUTION, at 9.—Radioactivity as a Kinetic Theory of a Fourth State of Matter: Prof. W. H. Bragg, F.R.S.

PHYSICAL SOCIETY, at 5 (at University College).—A Demonstration of Phase Difference between the Primary and Secondary Currents of a Transformer by means of a Simple Apparatus: Prof. F. T. Trouton, F.R.S.—A Note on the Experimental Measurement of the High Frequency Resistance of Wires: Prof. J. A. Fleming, F.R.S.—(1) The Measurement of Energy Losses in Condensers traversed by High Frequency Oscillations; (2) Some Resonance Curves taken with Impact and Spark Discharges: Prof. J. A. Fleming, F.R.S., and G. B. Dyke.—Council Meeting at 4.30 p.m.

SATURDAY, JANUARY 28.

ESSEX FIELD CLUB, at 6 (at Essex Museum of Natural History, Stratford).—Exhibition of Coloured Photographs of Alpine Flowering Plants: Somerville Hastings.—Note on the Occurrence of Stony Beds underlying Harwich Harbour: Percy Thompson.—On a Pre-historic Interment found near Walton-on-Naze: Hazzledine Warren.

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THURSDAY, JANUARY 26, 1911.

THE SCIENTIFIC MEN OF AMERICA.

(1) *American Men of Science. A Biographical Directory.* Edited by J. McKeen Cattell. Second edition. Pp. viii+576. (New York: The Science Press, 1910.)

(2) *Leading American Men of Science.* Edited by D. S. Jordan. Pp. vii+471. (New York: Henry Holt and Co., 1910.) Price 1.75 dollars net.

THESE two books bear very similar titles, but they are nevertheless of totally different character, for whilst the first is an exhaustive dictionary of all the men of science at present living in the United States and Canada, the second consists of a series of biographical sketches of seventeen men of science who have all passed to the majority, but the period of whose activities range from the time of the foundation of the American Republic until last year. Prof. Simon Newcomb, who contributed one of the sketches to this volume, is himself the subject of another, and he died as lately as June 11, 1909.

(1) Turning our attention to the first volume, we may say at once that it constitutes a most valuable record. Under each name are given all the particulars which can be crammed into a small paragraph. We are informed not only as to the nature of each man's present position, but also as to that of every other position which he has occupied since graduation, and an outline of the nature of his contributions to scientific knowledge is appended. A full list of his degrees and other academic distinctions is likewise given. For the compilation of such a record no one could be better fitted than the editor, Prof. McKeen Cattell, who has taken such a large part in the organisation of American science, and is sometimes affectionately nicknamed by his colleagues, "the Lord Pooh-Bah of American science." The only doubt which rises in one's mind as to the utility of so complete a work is occasioned by the very frequent changes of position which occur in the American scientific world; for whereas in the older Eastern universities the tenure of a chair is almost as secure as in Europe, it is of the slenderest character in many of the newer institutions. Cases are not unknown of a newly-appointed president "sacking" almost half his staff, but the situation is not without its compensations, for dismissal by no means connotes disgrace, and the discharged members of the staff usually succeed in finding other posts before long.

The book which we are considering now appears in its second edition, but its first edition was issued in 1906. If it is to serve as an accurate guide to the addresses and positions of American men of science a new edition every year will be required. To the alphabetical list of names, Prof. Cattell has added about fifty pages dealing with the conclusions, at which he arrived by the use of statistical and graphic methods on the mass of material out of which the book is constructed. We may be permitted to hesitate before accepting Prof. Cattell's belief in the possibility of quantitatively estimating the "amount" of scientific ability which an investigator possesses. Prof. Cattell secured the cooperation of 120 "leading men" of science, to whom were submitted the names of their colleagues in their respective sciences. These names were then arranged in order of merit by each of them, and the final position of each man of science in the scale of merit was determined by the average of the positions assigned him by this "judicial committee" of his colleagues. It seems to us that the "probable error" involved in these estimates is so large as to vitiate almost entirely the value of the tables. Some of the minor conclusions, however, which Prof. Cattell draws are of interest. Judged by the number of scientific positions and by the number of men of science born there, Boston and the surrounding parts of the State of Massachusetts are still the intellectual centre of the country. The States of the middle west rank high when we consider the very recent origin of their universities, whilst the south constitutes, relatively speaking, an "intellectual desert."

Prof. Cattell has some weighty words to say about the inadequacy of the remuneration doled out to those who give their lives to scientific work. Next to the "bearing and rearing of children," he considers that creation in science and art is the most important service that can be rendered to the State, and he adds that

"No one can know that his work is of value except by the reflected appreciation of others, and in the existing social order the most adequate expression of this appreciation is direct payment for services rendered."

And again:—

"If the scientific man in the government service receives the salary of a clerk and is subject to the orders of a superior he will be treated like a clerk, *and in the end will deserve no better treatment.*"

Space forbids us to pursue this important subject further, but now that the daily Press is endeavouring to find reasons for the aggressive vigour of the German nation in commercial matters, there is irresistibly recalled to the writer's mind the occasion on which he joined in the International Zoological Congress in Berlin. On that occasion the Imperial Government placed at the disposal of the congress both Houses of Parliament. Important members of the Cabinet were deputed to assist at the general meetings, and the streets of Berlin were cleared by a police force, whilst the Kaiser "reviewed" a procession of members of the congress. The imagination staggers in the attempt to picture this state of affairs in England, but one cannot help wondering whether the attitude of respect to pure knowledge displayed in such acts has not just as much to do with Germany's success as her judgment in the matter of tariffs.

(2) The seventeen essays contained in the volume entitled "Leading American Men of Science" are of very unequal merit. Some of them, notably that by Mr. Slosson on Count Rumford, and those by Mr. Stone on the two American ornithologists, Wilson and Audubon, are charmingly written, and a great deal more interesting than most "short-story" romances, but others, possibly on account of their less

interesting subject-matter, are much duller compilations. The title "American" is given its widest possible connotation, for whereas Benjamin Thompson, later Count Rumford, was born in America, and with American versatility, served on both sides in the Revolutionary war, yet the whole of his scientific career was passed in Europe, and in London he founded the Royal Institution; on the other hand, Louis Agassiz was born in Switzerland, and only went to America as a man of science of established reputation when he was forty years of age. The word "leading" also by no means always signifies pre-eminence in research, for amongst the seventeen immortals we find the names of chemists like Silliman, and zoologists like Baird and Goode, who are remembered rather for their successful efforts to build up scientific institutions than for "epoch-making" research. The two last-named are associated with the development of the United States Fish Commission, and Dr. Goode, in addition with the building up of the National Museum in Washington.

But amongst the most interesting biographies from certain points of view is that of Prof. Willard Gibbs, who devoted his life to the working out of abstruse principles in mathematical physics, and produced results of such high importance that American students studying physics in Berlin were set to master the work of their own fellow-countryman, about which they had previously known nothing. That in a country so full of "hustle" and of the utilitarian spirit, a position should be found for such a man in which the sole duties were to instruct four or five advanced students in his speciality, augurs well for the intellectual future of America. A similar feeling is called to one's mind by the case of a brilliant investigator prematurely cut off, whose name has been, as we think, unadvisedly, omitted from this list; we refer to Prof. Charles Ward Beecher, of Yale, who described the anatomy of Trilobita. In his case also his teaching duties were light, and did not extend over more than five or six weeks in the year, and all the rest of his time was devoted to research; and the tangible results of his researches in palæontology, after they had been described in publications, were deposited in the museum, which was in this way built up. If with Prof. Cattell we consider that

"if he is to be regarded as a benefactor who makes two blades of grass grow in the place of one his services would be immeasurably greater who could enable two men of science to flourish where one had existed before,"

then the University of Yale, to which Prof. Willard Gibbs also belonged, must take high place in the rank of benevolent institutions.

One of the most valuable features of the volume under review is the account which it gives of the investigations of those of its subjects who were renowned for research. This account is presented in such a way as to be intelligible to the reader who is not a specialist. The editor, President Jordan of Leland Stanford University, has prefixed a preface in which are some things well worthy of being emphasised. "In the extension of coordination of human experience," he says, "lies the only permanent wealth of nations. And in this view is found the keynote of the present volume." Again:—

"As we understand better the universe around us our relations to others and to ourselves, the behaviour of our race becomes rationalised. It becomes possible for us to keep ourselves clean and to make ourselves open-minded, friendly, and God-fearing."

The spirit to which these lines give expression and which is reflected in the lives recorded in this volume is the better leaven of democracy. While to many at a distance the American Republic seems a seething mass of blatant and utterly unscrupulous commercialism in which the professor is regarded by the rich as a mere hired servant, and by the poor as a half lunatic "crank," yet on a nearer view it is seen that his disinterested devotion to truth does not fail of its reward, for nowhere else in the world are the dicta from the professorial chair given such wide publicity by the Press, and nowhere else have they such influence with the "sober second thoughts of democracy."

E. W. M.

THE FABRIC OF PHARMACY.

Chronicles of Pharmacy. By A. C. Wootton. Vol. i., pp. xii+428. Vol. ii., pp. v+332. (London: Macmillan and Co., Ltd., 1910.) Price, two vols., 21*s.* net.

IN the preface to this very interesting and attractive work, Mr. Wootton tells his readers that his original intention was to trace back to their authors the formulas of the most popular of our medicines, but that during the course of his researches he was tempted to stray into various by-paths. Few of those who take up the "Chronicles of Pharmacy" will regret that the author succumbed to such temptation and extended his investigations beyond the limits to which he had originally intended to restrict them.

The title is well chosen. The work does not profess to be a systematic history of pharmacy but a series of contributions in which the author shows how kings, quacks, philosophers, priests, men of science and others have contributed to build up the fabric of pharmacy and mould it into its present form. It has been well said that no subject can be thoroughly grasped and properly appreciated until its history is known, and this is undoubtedly true of pharmacy, yet how few pharmacists have any adequate knowledge of their profession or of the long series of modifications through which many of the preparations they daily handle have passed before acquiring the composition given to them to-day? Such information Mr. Wootton now offers them, and in a form so fascinating that, having once commenced to read, it is difficult to lay the work aside until the end is reached. From first to last the attention of the reader is riveted to the subject by the romance which the author has so skilfully delineated.

The work is divided into twenty-four chapters. From the first, which deals with the myths of pharmacy, the author passes to pharmacy in the time of the Pharaohs, of the bible, of Hippocrates, of Galen, of the Arabians, and of Great Britain. "Dogmas and Delusions," "Masters in Pharmacy," "Royal Pharmacists," "Chemical Contributions to Pharmacy,"

and "Medicines from the Metals" complete the first volume. Of the ten chapters in the second volume the most interesting are "Animals in Pharmacy," "Some Noted Drugs," "Familiar Medicines," "Noted Nostrums," and "Names and Symbols."

The state of pharmacy in the time of the Pharaohs is illustrated by a very concise but sufficiently complete account of the celebrated Papyrus Ebers, which is made more realistic by the reproduction of one of its pages. Comparison of the preparations prescribed in this historically invaluable collection of recipes with those employed in this country three thousand years later affords food for reflection; such comparison is easy, for several of the paragraphs are literally translated, and can be read side by side with several from Cockayne's "Leechdoms, Wortcunning and Starcraft," which soon follow in the same volume. The chapter in which these are quoted ("Pharmacy in Great Britain") makes very interesting reading for British pharmacists. Here the reader is introduced to a number of celebrities who have taken active part in the development of pharmacy in this country, and is made acquainted with the circumstances that ultimately resulted in the formation of the Pharmaceutical Society of Great Britain.

But perhaps the most interesting and certainly the most novel chapters in the work are the three that deal with "Noted Drugs," "Familiar Medicines," and "Noted Nostrums." In them the author was at his best, and it is not difficult to see that these were the chapters that lay nearest his heart. They constitute the first systematic attempt to compile a history of preparations and medicines the names of many of which are household words. Black draught, diachylon plaster, Dover's powder, sal volatile, hiera picra, and many others are discussed. The expert will speedily realise the lengthy and patient investigation that must have been needed to discover and sift the facts here presented in small compass. Full use has evidently been made of the literary treasures in the library of the Pharmaceutical Society, where Mr. Wootton was frequently to be seen deeply engaged in the study of old volumes. Probably few pharmacists are aware that the original formula for diachylon plaster was compiled during the reign of the Emperor Tiberius, or that hiera picra could be purchased in Rome or Alexandria two thousand years ago as it can be in London to-day; in both cases the principal constituents have remained the same though the adjuncts have varied. So also the chapter on "Noted Nostrums" contains most instructive accounts of remedies so familiar to the pharmacist as James's fever powder, Ward's paste, St. John Long's liniment, Warburg's tincture, and others. Moreover, it is impossible to read these chapters without insensibly acquiring a considerable knowledge of the changes through which pharmacy itself has passed.

Mr. Wootton's "Chronicles of Pharmacy" must be regarded as a very valuable contribution to the history of pharmacy, particularly in this country. It is written in scholarly style, is of absorbing interest, and shows abundant evidence of painstaking research. Though the pleasure felt in perusing it is tempered with regret that the author should not have lived to see the publication of his work, it is fortunate he should have had, in Mr. Peter MacEwan, an accomplished literary friend, able and willing to undertake the task of revising the proofs before the work was finally submitted to the public.

HENRY G. GREENISH.

THE CHICAGO TEXT-BOOK OF BOTANY.

A Text-Book of Botany for Colleges and Universities. By Prof. J. M. Coulten, late Prof. C. R. Barnes and Prof. H. C. Cowles. Vol. i., Morphology and Physiology. Pp. viii+484+xii. (New York: American Book Co., 1910.) Price 2 dollars.

IT is a difficult task, nowadays, to write a text-book of botany, because the subject has become so large as to render it impossible to treat even the more important sections of it within reasonable limits of space. Any attempt of this kind must be judged on the basis laid down by the authors, and from this point of view we think the new Chicago text-book has scored a distinct success.

The subject-matter is divided into morphology, dealt with by Prof. Coulter, physiology by the late Prof. Barnes, and ecology by Prof. Cowles. In the volume just issued the first two topics are treated. The section of ecology will, we understand, be published shortly. The book as a whole is organised on the general plan of study pursued at the Hull Botanical Laboratory of the University of Chicago, and general interest will be aroused in its appearance since this laboratory is one of the most active centres of botanical research in America.

We confess to a feeling that the subject has suffered from compression, but it may be taken, after all, that the text-book is rather a reminder than a source of the more important topics of instruction given in the lecture-room and the laboratory. One feels this, especially in the portion dealing with morphology. Prof. Coulter must have found it a hard task to pick out of the immense mass of material just the matter that would best serve his purpose, but we fancy that many who belong to a class more advanced than those who are officially known as students, will find the book useful. He has, we think, very successfully eluded the rather stereotyped grooves, and has modified the perspective of his part of the work. There is a freshness, and that indefinable sense of first-hand acquaintance with the matter in hand, which in spite of the inevitable brevity imposed by limitations of space, cannot fail to appeal favourably to the reader.

After a general survey of the various groups of plants, in which not only the results of recent work are incorporated, but a large number of new figures are introduced, Prof. Coulter concludes with a chapter on organic evolution. It need scarcely be said that the pages devoted to this question are interesting, but we feel inclined to join issue with the author on one point. In dealing with variation, he says that the difference between what is known as natural selection and mutation consists in the fact that the former deals with fluctuating variations which are small, while the latter depends on large variations. But surely the matter is not really a quantitative but a

qualitative one. Fluctuating variations *may* be (and sometimes are) very considerable, while mutational changes *may* be extremely small. The difference between them may perhaps be best appreciated by saying that a fluctuating variation is the outcome of a changed environment on an otherwise unchanged mechanism, whilst a mutation is the result of a changed internal mechanism, and even with a constant environment the product will not be identical with that of the unchanged type reacting with a similar environment. It is the change of the vital machinery which *necessarily* will shift the metabolism of the organism into a new channel, and henceforth will produce a new form, stable, until once more the constitution, or chemico-mechanical framework of the race, undergoes further modification. The change itself may be small or it may be large, but it is essentially in its occurrence at all, and independently of its magnitude, that the production of a mutation depends. Furthermore, that to this *new constitution* is owing the circumstances that mutants are on such a different plane from fluctuating varieties so far as reversions are concerned. It may be argued that this smacks rather of hypothetical statement than of proved explanation of the facts, but it may be urged that fluctuating variations and mutations at any rate do express *distinct kinds* of variations, that these are not merely quantitatively different, and that it is therefore probable that they depend on the existence of different factors, in the two categories.

The second portion of the volume deals with plant physiology. It is written in the incisive style we have been accustomed to expect from the late Prof. Barnes; the arrangement of the material is good, and the mode of presentation appears to us to be very well suited to the requirements of those classes of students for whom it is designed. A cautious attitude which is much to be commended on general grounds is observed towards many "explanations" of physiological phenomena. Many interesting data not commonly met with in works of this kind are included, and render the book valuable to student and teacher alike.

It will be apparent from the foregoing that we expect the "Chicago Text-book" to take its place as a valuable addition to the class books of botany, and we hope the appearance of the concluding part may not be long delayed. J. B. F.

PRACTICAL ZOOLOGY.

Leitfaden für das zoologische Praktikum. By Prof. Willy Kükenthal. Fünfte umgearbeitete Auflage. Pp. viii+320. (Jena: Gustav Fischer, 1910.) Price 7 marks.

IT is a significant fact that no British zoologist has yet thought it worth while to write a text-book of practical zoology on the lines of Prof. Kükenthal's admirable work, which has now reached its fifth edition. The reason is perhaps to be found in the fact that zoology is so very lightly esteemed by those who have the ordering of our educational system. For this no doubt zoologists themselves are largely to blame. The specialisation of original research during the last twenty years has led to the accumulation of an enormous number of facts, which, though valuable and interesting in themselves, are from the educational point of view to a very large extent redundant.

The student is expected to familiarise himself with a vast mass of minute morphological, embryological, and systematic details, as well as with a great deal of more or less speculative matter, much of which has not yet stood the test of time. He can scarcely see the wood for the trees, and realises that the subject has become one of the most difficult, if not quite the most difficult, which he can take up for examination purposes. At the same time, the almost complete absence of zoology from our school curricula renders the subject comparatively useless from the point of view of the student who is qualifying himself as a teacher. In Germany the study of zoology appears to be much better appreciated, and this is probably largely due to the fact that teachers treat it more reasonably and do not expect their students to accomplish an impossible task.

The work before us affords an excellent survey of the animal kingdom from the laboratory point of view. It is divided into twenty "Kurse," each dealing with a special group of animals. We do not know how long each "Kursus" is supposed to occupy, but the subject-matter dealt with in each would in this country be regarded as far too much for a single practical class. Thus the frog, the pigeon, the lizard, and the rabbit are each dealt with in a single "Kursus," and so are no fewer than thirteen types of Protozoa. Each "Kursus" consists of technical instructions, a general review of the group or groups dealt with, and a special description of selected types.

The plan of the work is very well carried out, and the numerous illustrations are excellent. Students of Marshall's "Frog," or Marshall and Hurst's Zoology, would no doubt regard the treatment of types as very superficial, but it is at any rate an open question whether it is not more important to gain a really comprehensive first-hand knowledge of the animal kingdom than to attempt to deal with a very small number of types in great detail. It must be borne in mind that Prof. Kükenthal's book is apparently intended for students of "Hochschulen," who are only taking a single year's work in zoology. For those who are able to take two or three years we do not doubt that the mode of treatment adopted in the English text-books above named would be preferable for the first year, but a work such as that under review, sufficiently amplified, is badly wanted for more advanced students in this country. A. D.

IONISATION OF GASES BY COLLISION.

The Theory of Ionisation of Gases by Collision. By Prof. John S. Townsend, F.R.S. Pp. xi+88. (London: Constable and Co., Ltd., 1910.) Price 3s. 6d. net.

IN various papers published during the last ten years Prof. Townsend has developed a theory of the ionisation of gases by collision, and has published experimental results which give it strong confirma-

tion. In this small book he now gives a connected statement of all his work.

The phenomena attending the passage of electricity through gases are in many cases very complex, but it has certainly been evident of late years that the fog which has covered the field of exploration is beginning to lift. Here and there we are able to see clearly for a little way and to grasp the relations of various points to one another. The simple and satisfactory theory of ionisation by collision, which Prof. Townsend has worked out, is an instance of this improvement. He shows in the first chapter of his book how electrons set free by the action of ultra-violet light or other agents from one wall of an ionisation chamber grow in number as they are guided across the chamber by a sufficient electric force. Collisions with gas molecules add fresh electrons to the stream, and when the force is not too great the number which eventually reach the opposite wall is an exponential function of the width of the chamber. He bases his explanation on the assumptions that (1) an electron must acquire a certain velocity before it can ionise a gas molecule by colliding with it; (2) a successful collision adds one, and only one, electron to the stream; (3) an electron after a collision, successful or not, has lost all the energy it previously possessed, and starts its career afresh. These assumptions can hardly be quite accurate, and the remarkable agreement between the calculated and the experimental results seems almost more than there is any right to expect. It is quite a satisfaction to find that the agreement does not hold in extreme cases, and that the failure is, as the author points out, in the right sense. The third assumption is certainly not always true; Prof. Townsend has himself shown, in later papers not discussed in this book, that an electron can acquire considerable energy in an electric field when moving through a very dry gas; in other words, that the electron does not then give up all its energy at each collision. Again, it is interesting to find that electrons are not to be supposed to be incorporated with the atoms with which they collide; or at least that it has been found possible to ignore such an effect. If the idea is a correct one, it seems unlikely that β-rays can ever be incorporated with atoms with which they collide. Thus the undoubted success of Prof. Townsend's theory opens up further questions of great interest.

In the second chapter it is shown that the positive ions must acquire far more energy than the negative before they can ionise. It is only when the electric force is very great that the influence of the positive ion is perceptible. When, however, the force reaches a certain value the combined action of the positives and the negatives is sufficient to multiply a small initial ionisation indefinitely, and there is a "discharge." The "sparking potential" can be calculated from the ionising coefficients of positives and negatives, as previously found by experiment, and here again there is an excellent agreement between calculation and actual test. A careful explanation is also given of the difference between the sparking potential and the potential necessary to maintain a discharge once started.

The argument of the book is generally quite clear, but there are occasional obscurities. On p. 23, for example, the statement is confused, though essentially accurate of course. "The element *dy* of these paths" is not a proper phrase.

The book is a welcome record of very useful and interesting work.

TWO PHOTOGRAPHIC ANNUALS.

(1) *Penrose's Pictorial Annual. The Process Year Book*. Edited by W. Gamble. Vol. xvi., 1910–11. Pp. x+192. (London: A. W. Penrose and Co., Ltd., n.d.) Price 5s. net.

(2) *The British Journal Photographic Almanac*, 1911. Jubilee issue. Edited by George E. Brown. Pp. 1348. (London: Henry Greenwood and Co., n.d.) Price 1s. net; cloth, 1s. 6d. net.

(1) "THE Process Year Book" has for its object the display of specimens of work done by each of the many and various processes of reproduction. Care is taken that each process is represented by a sample obtained with the maximum of efficiency of that process. The volume thus gives the reader an idea of the standard of the workmanship of to-day attained in each case, and also a comparison between the different kinds of results that can be secured.

There is no doubt that many of the processes of reproduction of to-day are really very fine, and a glance through these pages will probably make the reader think that it seems scarcely possible to produce better work. Yet those who are closely associated with the subject, and they are the people who know the true failings, take a somewhat pessimistic view. Thus the editor in last year's annual was of the opinion that the beautiful processes were on the downward grade, and in this volume he states "it cannot be said that the situation is much changed." The race for speed and large output, coupled with no time or desire to experiment, are among the reasons he gives for this halt, or rather retrograde movement.

Nevertheless the volume before us demonstrates that a very high stage of efficiency has already been reached, and it is possible that because such rapid progress in advancement as previously made is not maintained now, this pessimistic view is held.

The amount and quality of the work embodied in this volume is a credit, not only to the editor, Mr. William Gamble, but to the publishers, Messrs. Percy Lund Humphries and Co., Ltd., and the proprietors, Messrs. A. W. Penrose and Co., Ltd. A large number of brief but interesting chatty articles on various branches of the subject are interspaced among the large number of illustrations, and the variety and high standard of the latter are to be highly commended.

Every trouble has been taken to give credit to those who have contributed to the volume, and it may be said that this issue even excels the very excellent volumes which have been noticed before in these columns.

Not only will the book be of high interest to all

acquainted with reproduction processes, but it should be consulted by those who wish to gain an idea of the many methods available. As a picture book alone the volume is cheap at the price of 5s.

(2) This very serviceable publication celebrates its jubilee in the present year. This series of almanacs commenced its life as a wall or sheet calendar, and appeared as a supplement to the *British Journal of Photography* in the year 1860. The current volume is decidedly bulky, and weighs 2·75 lb. Appropriately, it passes in review its past history, and contains a number of portraits of editors and publishers, past and present.

Our photographic readers are all familiar with the general nature of the contents of recent issues, so that it is not necessary to recapitulate these. The epitome of progress, contributed by the editor, is a conspicuous feature as usual, and gives a very useful set of classified abstracts of papers, communications, and articles describing the progress made in technical photography, which have appeared in the British and foreign Press during the twelve months ending October 20, 1910. This alone occupies about 140 pages. Another subject treated, most helpful to those who cannot make themselves acquainted with it first hand, is that which deals with recent novel introductions in photographic apparatus; the eighty-six pages devoted to this are deserving of close attention. The formulæ for photographic processes, covering sixty-seven pages, and the instructions for the use of commercial photographic materials, occupying sixty-five pages, are valuable features to have brought together under one cover. The various tables—chemical, exposure, optical, &c.—and the directory of photographic bodies and societies, all of which are brought well up-to-date, seem to show the mass of useful material embodied in this almanac.

No mention has yet been made of the useful and well-indexed advertisements, which take up nearly two-thirds of the 1348 pages, that compose the volume. These in themselves are very handy for reference. The jubilee number is thus a fitting volume for the occasion, and should, as usual, be in every photographic studio or laboratory.

GEOLOGY AND LANDSCAPE.

Geologische Charakterbilder. Edited by Prof. Dr. H. Stille. Heft ii., Grosse erratische Blöcke im norddeutschen Flachlande. By F. Wahnschaffe. Pp. v+6 plates. Price 3.60 marks. Heft iii., Das Karstphänomen. By A. Grund. Pp. iii+6 plates. (Berlin: Gebrüder Borntraeger, 1910.) Price 4.80 marks.

THE object of these "Charakterbilder" is to provide geologists with a series of illustrations of natural phenomena, which shall be accurate and typical. The authors are selected for special knowledge, and supply several pages of text, printed on sheets of the same size as the plates. The plates, however, are loose, and can be used in the work of small classes, or can be framed for laboratories.

Herr A. Grund deals with the features of the karstlands, and surely a grey instead of a brown tint would have done more justice to the pictures that he has brought together. Except for welcome patches of *terra rossa* round the dolinas, sometimes perhaps turned up newly by the plough, the impression of the karst is eminently white or grey. A few dark trees, themselves almost colourless, break or serve to emphasise the monotony of the slopes. The author aptly compares the dolinas to the valleys of normal areas; they are the channels that lead off the water in a permeable land. The character of a plateau is, moreover, preserved without marked local dissection, in a district where there can be no considerable surface-streams. A peneplane, once established, long remains a peneplane. An interesting discussion is given in connection with plate ii., as to why the limestone or karst areas of higher latitudes, as in Moravia or Champagne, are covered with vegetation, in opposition to those of the Mediterranean region. The chief factor is held to be weathering by frost, which soon cumbers the surface with blocks that promote a soil. Signs of mechanical weathering are almost absent in the barren karstlands. A typical polje is shown from Herzegovina in plate vi., with its alluvial floor contrasting sharply with the desolate limestone hills. In this case the form of the basin is attributed, as in many Bosnian examples, to the deformation of a valley-floor by earth-movements.

Herr Wahnschaffe had a simpler task in describing, in the previous part, a number of large erratics found on the North German plain. The greatest of these, a mass of garnet-mica-gneiss, occurs in a churchyard at Gross-Tychow in Hinterpommern, and measures, above ground, 3·74 m. in height, 15·90 m. in length, and 11·25 m. in breadth. The thick-set fir-woods that surround most of these wanderers from Scandinavia form "Charakterbilder" in themselves. The author provides a clear, brief essay on the history of the theory of glacial transport, beginning with Playfair in 1802.

G. A. J. C.

FOSSIL REMAINS OF MAN.

Der Stand unserer Kenntnisse vom fossilen Menschen. By Prof. W. Branca. Pp. viii+112. (Leipzig: Veit and Co., 1910.) Price 2.50 marks.

WITHIN the last few years there has been a marked recrudescence of interest in the study of the fossil remains of man, and the stream of literature relating to the subject has suddenly become so voluminous that the torrent threatens to overwhelm those readers who cannot devote their whole time to its perusal. In these circumstances any attempt to summarise and criticise this recent work is likely to meet with a hearty welcome, even though, as the author of this work frankly admits, it is far from complete.

Like the compiler of an analogous report on the same subject in this country (Sollas, presidential address to the Geological Society, 1910), the author of the book under review is a geologist, and as such he deals in a critical spirit with the determination of the age of the remains of diluvial man, insisting upon the need for placing chief reliance upon stratigraphic evidence, secondarily on that afforded by associated

animal remains, and least of all on the productions of man's industry.

He deals mainly with evidence which has come to light since 1901, when he discussed the whole subject at the International Zoological Congress.

After describing the distinctive features of the two main cranial types found in diluvial times—the higher or Cro-Magnon type, "which still persists in Europe," and the lower or Neanderthal type, "which still persists in Australia"—he describes specimens from Cheddar, Terra d'Otranto, Monteferrand-Périgord, Mentone, and Galley Hill as examples of the former, and those from Krapina, Vezere, Heidelberg, and Corrèze of the latter, but makes a third (intermediate) group to include some of the Mentone crania.

There is no reference to the Gibraltar skull or to any recent English writings, except those of Mr. Macnamara; but he quotes at length from Rutot's memoirs on the Galley Hill skull, which assign to it a singularly great importance as "the geologically oldest diluvial human remains," taking care to add "if M. Rutot is right."

After a destructive criticism of Ameghino's supposed Tertiary remains of man found in South America, he discusses the question whether the inferior type of diluvial European cranium is older than or ancestral to the higher type, and comes to the conclusion that there are many difficulties in the way, including the possibility that the higher type of skull may be older than the lower type.

He argues against the derivation of man from any such anthropomorpha as the existing man-like apes. There is an interesting chapter on fossil anthropoid apes, great stress being laid, and quite justly so, on Schlosser's recent discovery in Egypt of a diminutive Oligocene anthropoid—Propliopithecus Haeckeli.

Startling surprises await the reader as he approaches the close of this sober, critical, and characteristically thorough teutonic analysis of the state of our knowledge of fossil man, for he finds a chapter devoted to the serious discussion of whether Pithecanthropus may not be the bastard offspring of the union of a woman and a male Gibbon! And no sooner has he recovered from the effects of this speculation than the author launches into a polemic against what he calls "the fanatics of the Church and monism"—the chief "clerical fanatic" being the genial and popular entomologist, Father Wasmann, and the "monistic fanatic," Prof. Haeckel. He ends the work with a confession of his attitude towards the Christian religion!

G. ELLIOT SMITH.

OUR BOOK SHELF.

Schopenhauer-Darwin: Pessimismus oder Optimismus. By Gustav Weng. Pp. 189. (Berlin: Ernst Hofmann and Co., 1911.) Price 2 marks.

THE author describes the "struggle for existence" in somewhat lurid language, as a preparation for the introduction of the doctrine of his master, Schopenhauer. The weak go to the wall, the fit survive. In a few millenniums there will be nobody but the happy strong. Life is a game, a gladiator-fight, and the survivor is the best. The process is unmoral or immoral, but "the end justifies the means."

After some clever cut-and-thrust at the progress-enthusiast, in the style of Carlyle's remark that it may be progress backward, towards the devil and the pit, Herr Weng indicates his own opinion as follows:—"The exact sciences confirm Schopenhauer's Pessimism in every detail. Therefore can he alone of all philosophers satisfy our Reason and our indestructible metaphysical needs, without denying nature-knowledge, or forcing on us religious fairy-tales . . . this philosophy knows no continuance of individuality after death. For it, the individual is a form of objectification of the Will to Live." This will to live must be denied; thus only can the contradiction which has arisen between moral law and natural law (struggle for life, immoral survival of the strong) be resolved. The end of the scientific progress-philosophy—Darwinian evolution—is pessimism: the choice is between a scientific pessimism with no redemption, and a philosophic pessimism which does admit of putting things right.

The foregoing condensation will give an idea of this rather one-sided yet readable little book. Its criticism of the evolution theory is itself open to criticism, for though that theory issues in pessimism from the purely materialistic point of view ("nature red in tooth and claw with ravin," cruel, pitiless of suffering) it does not follow that the point of view is the right one. There may be meaning and purpose in all suffering, and an optimistic philosophy may be possible by extending the principle of development into a spiritual world. The assumption that the world exists for our education, says Emerson, is the only sane solution of the enigma.

J. A. H.

Die experimentelle Grundlegung der Atomistik. By W. Mecklenberg. Pp. viii+143. (Jena: G. Fischer, 1910.) Price 2.50 marks.

THIS book is an extended reprint of articles which have recently appeared in *Die Naturwissenschaftliche Wochenschrift* and were written with the purpose of giving an account of the recent additions to our knowledge about molecules, their mean free path, radius, mass, &c., It is intended in the first place for chemists and physicists who have not time to consult original papers, but as the mathematics are exceedingly simple, the author hopes it may be suitable for a semi-popular audience.

There is first an account of the different means of obtaining molecular data from the kinetic theory of gases. Also, it is shown how the radius of the molecule may be calculated from the molecular refraction or from the constant of Van der Waals's equation. Then follows a section on the Brownian movement, in which the recent work of Perrin and Svedberg is described. There is also an account of the ultramicroscope and the continuity of suspensions and solutions. Finally, we have a section, which is fully up-to-date, on the more hackneyed subject of electrons and the atomic theory of electricity. At the end of the book there is a list of references and an index of names. The book is thus very complete, and gives a large amount of information for its size, and the style is clear and interesting.

According to the author, it has been the chief function of the recent physics and chemistry to prove the existence of atoms by direct experiment, the word atoms being used in the widest possible sense; before, it could only be inferred indirectly. Hence the title of the book, "The Experimental Founding of the Atomic Theory." In this his point of view appears to us somewhat artificial. While we have now no doubt a much stronger faith in atoms, yet that has come only in the train of other ideas, and does not accurately describe the change in our outlook.

The table mentioned on pp. 25 and 40 as being at the end of the book is really at p. 64.

Kant and His Philosophical Revolution. By Prof. R. M. Wenley. Pp. ix+302. (Edinburgh: T. and T. Clark, 1910.) Price 3*s.*

IN a letter to Stägemann, in 1797, Kant made a seemingly arrogant remark. He said: "I have come with my writings a century too soon; after a hundred years people will begin to understand me rightly, and will then study my books anew, and appreciate them." And indeed the estimate and the prophecy were supported by the most brilliant historian of modern philosophy, and by the writer of the best book on Kant in our tongue—by Kuno Fischer and Edward Caird, namely.

The prophecy no doubt refers to the "Critiques," but Kant's contributions to science are important also. The "Cosmogony"—admirably translated by Hastie—is an astonishing book. It forecasts the conception of evolution, and its scheme is adjustable to all discoveries since made. "Law replaced Lucretian chance, simplicity expelled Cartesian involution, mechanism dispersed the clouds of mysticism raised by Malebranche." Herschel and Laplace were anticipated, and their very errors avoided with marvellous intuition. Where Kant made mistakes, it was inevitable, often owing to lack of mathematical resources, as in his calculation (for the first time) of Saturn's diurnal period.

In metaphysics, Kant's fame is, of course, that of a destroyer. He demolished the various famous "proofs" of God, freedom, and immortality. So far as reason goes, the analysis of the first and most famous "Critique" compels an agnostic attitude, and "man is thrust back powerless in face of his own most characteristic expressions and need." In the later works, they are justified as postulates or necessary hypotheses of the practical reason, giving occasion to Heine's famous sneer.

Prof. Wenley gives an excellent sketch of the condition of Germany in Kant's time, both intellectual and material, and his careful bibliography will be of use to many students. The style is popular and lucid —a difficult thing to manage in an exposition of a writer who uses such terrible terminology as we find in the "Critique of Pure Reason."

Plant Life in Alpine Switzerland, being an Account in Simple Language of the Natural History of Alpine Plants. By E. A. Newell Arber. Pp. xxiv+355+xlviii plates. (London: J. Murray, 1910.) Price 7*s.* 6*d.* net.

IT is exceedingly true, as the author remarks, that a large number of visitors to Switzerland are aroused to great enthusiasm by the masses, brilliant colouring, and variety of the Alpine flowers. Whether their enthusiasm is sufficiently deep to induce biological inquiry and observation in many cases is doubtful, but the author is likely to be quite content if only a small proportion is led to take an intelligent interest in the information which he has set out with evident care and admirable clearness. Also, it may be expected that not a few botanists will be glad to avail themselves of the author's introduction to Schroeter's, Christ's, and Bonnier's studies.

The details are marshalled under genera, while the genera are arranged according to habitat, so that the chapters treat of alpine pastures, meadows, marshes, forests, and the high alpine region. Biological features provide the chief themes, among which may be noted pollination, structural modifications, colour and colour variation discussed in connection with the gentians, fruit of the anemones and Geum and contractile roots of Veratrum; cushion, carpet, and rosette plants are dealt with in the chapter devoted to the high alpines, although it is intimated that rosette plants are quite as numerous in lower alpine localities. A very large number of genera are included; of these, the willows, *Salix reticulata* and *Salix herbacea*, would generally escape notice, while the Papilionatæ and louseworts would attract more attention than they receive here. In the last chapter the author presents an interesting sketch of modern hypotheses regarding the origin of the Swiss alpine flora. A glossary and an introductory account of floral structure are supplied in the appendices; these should render the book intelligible to readers who have had no botanical training, as the author's style is simple and explicit. Finally, a word of commendation should be accorded to the excellent illustrations and the useful diagrams, the latter prepared by Mrs. Arber.

Index to Desor's Synopsis des Echinides Fossiles. By Dr. F. A. Bather, F.R.S. Pp. 46. (London: The Author, at "Fabo," Marryat Road, Wimbledon, 1910.)

BY the publication of this index Dr. Bather has supplied a long-felt want and has done a valuable service to all students of living and fossil echinoids. Needless to say, he has carried out his important task with great care and thoroughness. The scheme adopted for the main part of the work is that which is employed by Mr. C. D. Sherborn in his well-known "Index Animalium"; that is to say, the first part of the index contains all generic and trivial names alphabetically arranged, while the second part sets forth the generic names, each one followed by an alphabetical list of all the trivial names which have been associated with it in the "Synopsis." Certain pages of Desor's work appeared in more than one issue and on varying dates, and due regard has been paid to these irregularities by a quotation of actual dates immediately following the page references in question in both parts of the index. Another important feature is the indexing of the plates, on which appeared some names that are not to be found in the text.

Systematic workers have always experienced much difficulty in ascertaining the dates of issue of the various fasciculi of the "Synopsis," and of the reissue of cancelled and revised pages, and it is therefore a matter for great satisfaction that the author has been able to include in this index a note on the dates of publication, contributed by such a high authority as Mr. Jules Lambert. It so often happens that nomenclatural accuracy is dependent on bibliographical precision that a special value attaches to Mr. Lambert's note and to an exhaustive collation, supplied by Dr. Bather, which immediately follows it.

Man's Redemption of Man. By Prof. W. Osler, F.R.S. Pp. 60. (London: Constable and Co., 1910.) Price 1*s.* net.

AN address delivered by Prof. Osler to students of the University of Edinburgh in July last is here presented to a wider public. The message is that of the gospel of science. By observation and thinking, the Greek philosophers grasped great principles and arrived at brilliant generalisations, but not until the secrets of nature were searched out by experiment did the scientific redemption of man begin. The mastery "Of Earth and Water, Air and Fire," is to be obtained by following the experimental method; and through it the conquest of disease and suffering may be confidently anticipated. Unnecessary pain was banished by the introduction of anæsthetics, Listerian surgery has revolutionised the treatment of wounds, while cholera, yellow fever, malarial fevers, and other epidemic diseases have been brought under control. Tuberculosis has yet to be stamped out, and the campaign must be carried on until it is in the same category with typhus fever, typhoid, and smallpox.

The occasion on which Prof. Osler delivered his lay sermon was the Edinburgh meeting of the

National Association for the Prevention of Tuberculosis. The trumpet-call is short, but its clear notes should inspire confidence in the ranks of the small army now fighting against ignorance and disease.

G.

Weather Instruments and How to Use Them. By D. W. Horner. Pp. 48. (London: Witherby and Co., 1910.) Price 6*d*. net.

This handy little work is intended chiefly for amateurs, but it includes descriptions of instruments required for a "second-order" station, while difficulties which the author thinks are apt to "scare off" novices are avoided. It contains much that is interesting and useful, but its reading leaves us with the impression that persons wishing to take up the subject seriously might at once turn to the handbooks and instructions issued by recognised authorities. Some instruments and methods not suitable for second-order stations are also included, and, naturally in so small a work, no tables are given. Under air-pressure the necessity of using accurate barometers is pointed out. Reference is also made to the so-called Fitz-Roy barometer, which, like the Gladstone bag, is, we believe, only a trade name; as it is easily read, it may, however, be useful to the ordinary individual, who merely uses the barometer as a "weather glass."

Willing's Press Guide and Advertisers' Directory and Handbook, 1911. Pp. xiv+457. (London: James Willing, Jun., Ltd.) Price 1*s*.

This is the thirty-eighth year in which this concise and comprehensive index to the Press of the United Kingdom has appeared. The volume also contains a list of the principal colonial and foreign journals and a variety of general information.

Field and Colliery Surveying. A Primer Designed for the Use of Students of Surveying and Colliery Manager Aspirants. By T. A. O'Donahue. Pp. xii+263. (London: Macmillan and Co., Ltd., 1911.) Price 3*s*. 6*d*.

A revised and enlarged edition of this book was published in 1909, under the title, "Colliery Surveying." The opportunity has been taken with this new issue to make further additions and to change the title so as to direct attention to the prominence given in the work to field surveying.

Solutions of the Examples in an Elementary Treatise on Conic Sections by the Methods of Coordinate Geometry. By Charles Smith. Pp. iv+377. (London: Macmillan and Co., Ltd., 1910.) Price 10*s*. 6*d*.

The master of Sidney Sussex College, Cambridge, here provides a "key" to the examples in the new edition of his "Treatise on Conic Sections by the Methods of Coordinate Geometry," published recently.

La Metallographie appliquée aux produits Siderurgiques. By U. Savoia. Pp. x+218. (Paris: Gauthier-Villars, 1911.) Price 3.50 francs.

This is a French translation from the Italian, and as the English equivalent has already been noticed in Nature (December 15, 1910, p. 202) nothing further need be said, except that the work of rendering into French seems to have been carefully done, and that there are altogether ninety-four illustrations in the text.

Key to Hall and Stevens's School Arithmetic. Part II. By L. W. Grenville. Pp. 174. (London: Macmillan and Co., Ltd., 1910.) Price 6*s*.

Busy teachers, and students working alone, will welcome these well-arranged solutions to the examples in the second part of Messrs. Hall and Stevens's "School Arithmetic."

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* Nature. *No notice is taken of anonymous communications.*]

The Inheritance of Acquired Characters.

In his very friendly notice of my little book, Prof. Meldola has invited readers of Nature to furnish an explanation of the source of a very "pregnant" passage—the only one dealing with the subject in question—in the "Origin of Species." Sir W. T. Thiselton-Dyer has clearly shown that the problem must certainly have been in Darwin's mind at least four years before the writing of the "Origin," when he was absorbed in the reading of the great work of Alph. de Candolle, and afterwards while writing the "Variations of Animals and Plants."

But, thanks to that important work, "The Foundations of the Origin of Species"—by the publication of which Dr. Francis Darwin has placed all students of the history of science under such deep obligations—I think it is possible to trace the actual "genealogy" of the passage, and to detect its origin, at a far earlier period.

In the pencil-written sketch of 1842 there occurs the following sentence in the equivalent position to the passage in question:—

"Most of these slight variations tend to become hereditary" ("Foundations," p. 1).

It is true that this sentence was erased by Darwin, but that this erasure was only due to the fact that he considered it unessential in the very brief outline of the theory of natural selection which he then "permitted" himself to make is, I think, proved by the circumstance that the statement appears in the enlarged and carefully written draft of 1844 in the following terms:—

"Most organic beings in a state of nature vary exceedingly little: I put out of the case variations (as stunted plants, &c., and sea-shells in brackish water) which are directly the effect of external agencies and which we do not *know are in the breed* or are *hereditary*" ("Foundations," p. 81).

The italics are Darwin's own. The context, I think, proves that "little" in this passage, like "slight" in the earlier one, refers to the *individual* variations, and not to their *accumulated result.*

In the first edition of the "Origin," and in all subsequent editions, as Sir W. T. Thiselton-Dyer points out, the statement runs:—

"Some authors use the term 'variation' in a technical sense, as implying a modification directly due to the physical conditions of life; and 'variations' in this sense are supposed not to be inherited"; he then goes on to refer to dwarfed shells, &c.

Now to realise what was at the back of Darwin's mind in writing these several passages, I think we must go back to the great controversy at the beginning of last century between Cuvier and his followers and the adherents of poor old Lamarck. The position taken up by the anti-evolutionists was that, while they admitted the transmission by inheritance of *small* variations, they stoutly denied that great changes in structure and habit, such as were required by Lamarck's theory, could be so transmitted.

Lyell, when he first read Lamarck's great work in 1827, was greatly fascinated by it, and down to 1830, and some time after that, became convinced (as his letters to Sedgwick, Whewell, and Herschel show) of the truth of the doctrine of organic evolution. But, as was the case with Darwin, a few years later, his ideas on the subject underwent many vacillations. He paid frequent, and sometimes prolonged, visits to Paris, where Cuvier showed him much kindness, inviting him to his receptions. Lyell, then still young and an ardent admirer of Cuvier's palæontological work, could not fail to be impressed by the arguments of the distinguished Paris circle, and we especially find that their studies of the Egyptian mummified animals and of the anatomy of the races of dogs had a very strong influence on his mind. Thus it came about that in 1832, when he wrote the second

volume of the "Principles," Lyell not only rejected the theory of Lamarck, but went far towards abandoning, for the time, any idea of "the transmutation of species."

It is scarcely necessary here to recall the fact that this second volume of the "Principles," so full of discussions bearing on the changes in organic life, reached Darwin in South America, just at the time when he was startled by discovering the relations between the living and recently extinct mammals of that continent. From that time forth Darwin no longer regarded the question of evolution with indifference. In the critical period between the return of the *Beagle*, in 1836, and the writing of the first sketch of the theory, in 1842, constant intercourse took place between the two friends: "I saw more of Lyell," says Darwin in his autobiography, "than of any other man, both before and after my marriage" (in 1839). In their frequent discussions, Darwin would become fully acquainted with the arguments of Cuvier and his school, which are, indeed, very clearly and trenchantly reproduced in the first three chapters of the second volume of the "Principles," which Darwin called his "own true love."

These facts borne in mind, I think we can have no difficulty in realising the source of the statements made by Darwin. I think the sentences may be paraphrased as follows:—

"Anti-evolutionists *admit* the inheritance of *small* variations. Well, the inheritance of such small variations is all I require for my theory of Natural Selection. I can afford to concede the non-inheritance of the greater variations."

But it is interesting to notice that in the sentence about plants and sea-shells following the passage in question, and in his discussion of the appearance and inheritance of a *sixth digit* in man, &c., Darwin was not satisfied that *only* small variations were transmitted.

It was the remembrance of facts like these that led me to suggest that the subject was "constantly present" in Darwin's mind. Prof. Meldola, thinking of the more acute discussion of the question aroused in 1885 by Weismann's declaration that *no* acquired characters are inherited, naturally expressed doubt on the subject, and I, of course, admit that this phase of the question, in all probability, never presented itself to Darwin, or at least never demanded his serious consideration.

Kew. JOHN W. JUDD.

The Transference of Names in Zoology.

As the preparation of an official list of *Nomina conservanda* is now under consideration by the International Commission on Zoological Nomenclature, it may not be out of place to direct attention to a point that seems to me of prime importance in this connection, although it has received little notice from recent writers on nomenclatural reform.

It is simply this—while the rejection and replacement of familiar names for well-known animals is, of course, an inconvenience to zoologists, it is a trivial matter in comparison with the grave possibility of confusion that arises when the names are used in an altered sense. In the former case we merely multiply synonyms, and, unfortunately, they are so numerous already that a few more hardly matter; in the latter case there is a real and serious danger of ambiguity. Thus, at present, a writer who mentions Trichechus may be referring either to the walrus or the manatee, Simia may mean either the orang or the chimpanzee, Cynocephalus may be either a "flying lemur" or a baboon, and so on through all the great groups of the animal kingdom until we come to Holothuria, which may refer either to a sea-cucumber or to a Portuguese man-of-war. Cases like these seem to me to be on an entirely different plane as regards practical importance, from those in which an old name is simply rejected; even if the shore-crab is to be called Carcinides for the future, we have only the additional burden of remembering that it was once called Carcinus.

A striking (if somewhat exceptional) instance of the pitfalls that are in preparation for future students is found in the section on Crustacea in Bronn's "Thierreich" (Bd. v., Abth. ii.). On p. 1056 there is an allusion to "Astacus," and on the following page to "Astacus (=Homarus)." In the bound volume (unless the part-wrappers have been kept in place) there is nothing to show that a change of authorship intervened between those two pages, and that, while the second "Astacus" refers to the lobster, the first indicates the crayfish.

If the International Commission could be persuaded to consider first those names that are threatened with *transference*, before proceeding to deal with those that are merely in danger of *replacement*, they would, I believe, secure the support and cooperation of many zoologists who have doubts as to the practicability of the schemes lately put forward. W. T. CALMAN.

British Museum (Nat. Hist.), Cromwell Road, London, S.W., January 23.

Sex Relationship.

IT seems a pity that writers should allow their political bias to influence their work, and especially that they should not at least ascertain the facts of a case before writing about it.

In his article on "Sex Relationship" in NATURE of January 5, Dr. R. J. Ewart said, in commenting on the present excess of females over males:—"The result of this is to produce in a community a section of women who cannot possibly perform that function for which they were fashioned. Their energies are naturally directed into other spheres, as evidence of which we see the revival of the movement for political recognition. The agitation is no new one, and apparently is dependent for its strength and virility on the position of the sex pendulum," &c.

Now, first, it may be observed that women are no more fashioned to perform a single function than men are; their natures are as complex, their brains as varied as men's—in fact, "God Almighty made 'em to match the men."

Secondly, the excess of females of all ages over males in this country is between one and two millions, while *five* million women earn their own livelihood. Thus a large number even of those who perform "the function for which they were fashioned" are obliged to "direct their energies to other spheres," quite irrespective of any excess of females.

Thirdly, there is no *revival* of the movement for political recognition—it has culminated. Since it first began with any vigour, in 1867, it has gone steadily on, and its greater activity during the last five years has been due to the genius and courage of two women, who had the political insight to realise that, by some curious quality in the psychology of men, the only tactics that are successful in obtaining a reform of the franchise are militant tactics.

Fourthly, the countries in which English-speaking women have already gained their political freedom are *not* those in which there is an excess of women over men, but are the comparatively new countries—New Zealand, Australia, and some of the western States of America.

Dr. Ewart errs in attributing to a purely physical cause a movement which really arises from a mental and moral awakening—and, indeed, his whole article is full of unsupported assertions and loose reasoning; but I should not have ventured to criticise it had he not so clearly allowed his judgment to be warped by his political bias.

HERTHA AYRTON.

41 Norfolk Square, Hyde Park, W., January 9.

I AM sorry that my little paper should have been taken as prompted by political bias. I am sure that its possible influence on the Suffragette question never entered my head. I should be quite willing to answer any question Mrs. Ayrton may care to put to me should she care to write me privately. I am not willing to enter upon a public correspondence. R. J. EWART.

The Health Department, Municipal Buildings, Middlesbrough, January 12.

The Origin of Man.

THE reference in "Dodsley's Annual Register for 1767," mentioned in NATURE of January 12 (p. 336), is to James Burnett, Lord Monboddo, whose speculations as to the simian origin of man excited so much ridicule amongst

his contemporaries. Boswell reports a saying of Johnson in 1773:—"Other people have strange notions, but they conceal them. If they have tails they hide them, but Monboddo is as jealous of his tail as a squirrel."

Burnett's work "On the Origin and Progress of Language," in which these speculations are put forward, only began to appear in 1773, but his views were evidently familiar at an earlier date. He became a Lord of Session in 1764.

CECIL H. DESCH.

University of Glasgow, January 16.

[MR. F. GILLMAN, Brook House, Matlock, has sent a letter to the same effect.—ED. NATURE.]

POPULAR ORNITHOLOGY.[1]

IN producing yet another book on the birds of Great Britain[1] the editor points out that one result of the growing interest taken during recent years in the study of ornithology is a considerable addition to our knowledge of the habits of British birds; that as no comprehensive British work on the subject has appeared since those of Yarrell (revised by Newton and Saunders) and Seebohm, this knowledge is only available by searching through a large and scattered literature; that the new edition of the Naumanns' work leaves unrecorded many of the observations on the habits of our birds that have been made in our own and other countries, and that there is therefore place for a work that will bring together from every source, foreign and native, all the available information of any importance concerning the habits of British birds. To do this, and to do it in a form interesting alike to the student of animal life and the general reader, is the chief object of the present undertaking. This is to say the least an ambitious project. In carrying it out the editor will have the assistance of the following writers, J. L. Bonhote, William Farren, the Rev. F. C. R. Jourdain, W. P. Pycraft, Edmund Selous, A. Landsborough Thomson, and Miss Emma L. Turner, who have been left to arrange and treat the matter within each section of a chapter written by them "in the way best suited to his style and temperament, thus avoiding cut-and-dried uniformity with its resulting aridity."

The plan of the book differs in some important particulars from that generally adopted. Each chapter deals, not with a species, but a family, thus not only emphasising the relationship of the species, but facilitating comparative treatment and avoiding unnecessary repetition of statements that apply equally to the whole family or genus. In many cases it has been found advisable to divide the chapter into sections. In the present volumes all the finch genera are taken together "owing to the marked similarity in the general habits of the species," while the crow family has been divided into groups. But when we find the magpie and the jay grouped together for the same reason as the finches and the raven separated from the crows, and all three from the rook and the jackdaw (which are taken together), it is quite evident that "rigid uniformity in arrangement has not been attempted."

The information most often needed for reference is placed at the head of the chapter, under the title of "Preliminary Classified Notes," and refers to each species separately. These comprise (1) description of plumage; (2) distribution; (3) migration; (4) nest and eggs and information as to incubation, number of broods, &c.; (5) food; and (6) period of the year during which the species sings. So far as we can judge from the present instalment, these have been carefully prepared, and contain accurate and concise information, a detailed account, however, of the geographical distribution, as expressly stated in the preface, lying outside the scope of this work, which professes to deal comprehensively only with their habits. Those portions of the chapters treating of the habits generally, and forming the greater part of the volume, are somewhat gossipy and discursive in character, and even bordering in parts on the whimsical, while their popular character may be indicated by a reference to the devotion of two-thirds of a page to such matter as an account of Charles Dickins's ravens.

Mr. Selous makes the startling statement that young goldfinches are not fed apparently more than once in an hour. But in a footnote we are told that the observations (on which the statement is founded) were, it is true, made in the United States, and the Latin name of the goldfinch was not given in the original paper. "Still, it seems probable that what applies to the North American species of goldfinch would apply to our own." Wild speculations on probability of this kind seem to be a waste of space. The "American goldfinch," as a matter of fact, is quite a different bird from our goldfinch, and is closely allied to the siskin. It is a pity that the author of this section did not learn its Latin name. We do not think this portion of the work will supersede our old friend "Newton's Yarrell."

The second volume treats of the buntings, larks, wagtails, pipits, the creeper and wren, in the order named, the treatment often inclining to the fanciful. In other places the grouping of the species, often diverse except in name, seems to have raised a slight difficulty, and some species—the shorlark, for instance—might well have received a fuller notice. Of

Photo by N. F. Ticehurst.

FIG. 1.—Blueheaded Wagtail's Nest and Young in Grass. From "The British Bird-Book."

[1] "The British Bird-Book. An Account of all the Birds, Nests and Eggs found in the British Isles." Edited by F. B. Kirkman. Vol. i., pp. xviii+156: vol. ii., pp. 140. (London and Edinburgh: T. C. and E. C. Jack, 1910.) Price 10s. 6d. net.

its habits in winter, however, we are told "little is known." But further research into literature and inquiry among observers should surely have corrected this.

A smear on the general attractiveness and beauty of the second volume is unfortunately to be noticed in the shape of a footnote wherein one of the contributors indulges in a petulant attack on reviewers. As the editor expressly repudiates responsibility for the statements made in the note he is doubtless alive to their exceedingly bad taste; but why deface the pleasing pages of the book with an acrid expression of pique which can only be of interest to one person in the world?

At the end of the work there are to be chapters on rare British birds, classification of British birds, distribution and migration of British birds, bird watching and photography, and bibliography. With regard

Photo by E. L. Turner.

FIG. 2.—Tree-creeper's Nest tn a crevice in a Tree. From "The British Bird-Book."

to the illustrations, the artists include Winifred Austin, G. E. Lodge, H. Grönvold, G. E. Collins, and A. W. Seaby. The coloured plates in the present volumes are exceedingly pleasing and charming in every way, and they certainly do answer the purpose for which they have been designed. Their object is to supply something more than a portrait of each species for purposes of identification. Each picture is, with few exceptions, to offer a study of some habit of the bird or of one of its most characteristic and striking attitudes; it is to show the bird in its natural surroundings, and the thirty-four plates in these volumes are, on the whole, quite a success. In addition, we have a coloured plate of eggs, numerous photographs of nests and eggs and young, an outline map of the world, showing the six zoo-geographical regions, and a diagram explaining the names of the various external parts and portions of the plumage of a bird. An index is promised at the end of the book, which is to be completed in twelve of these sections or volumes.

The twenty plates of eggs which, with very short letterpress, are meant to supplement the "Sketch Book of British Birds," can hardly be said to be worth publication.[1]

The book is, in fact, too cheap. We cannot expect twenty coloured plates for five shillings, and the cheap reproduction has been a failure. Yet it was hoped that by having a faithful representation of one normal specimen of each species a key would be furnished by which identification might be made comparatively easy. This hope would have been better sustained, poor as the figures are, had they been correctly named. But, turning to plate iii., we find the egg of the black-throated thrush referred to the rock thrush and *vice versa,* that of the "American thrush" (*Turdus migratorius*) to the redwing, that of the redwing to the missel thrush, and that of the missel thrush to the American thrush; while on plate xv. the eggs of the purple sandpiper and little stint do duty for one another. We have not had patience to go through all of them. This deplorable confusion has been caused by the careless insertion of the reference numbers. But it is fatal to the key, and will prove fatal to the beginner's attempt to identify eggs. A few lines of letterpress are devoted to each species. Turning to that relating to this plate xv., we find the wood sandpiper called the wood "tattler," an American name not in use in England, and the information that the pectoral sandpiper is an American species the nest of which is built on high grassy slopes in Lapland! It is no longer correct to say that the eggs of the knot are still unauthenticated.

THE SEA-OTTER.[2]

SOME twenty years ago, in the days of the Bering Sea question, Captain Snow was well known as an authority on certain of the fur-seal fisheries of the North Pacific, and he was, and still is, known as one of the few authorities on the geography of the Kurile Islands. He has now written a pleasant book telling some of his manifold adventures in this region of the world, and, above all, relating his experiences in pursuit of sea-otter. There is an interest which amounts to fascination in this singular animal. Fifty years ago it was comparatively plentiful all round the coast of the North Pacific, from California and Oregon to Kamtschatka and the Kuriles, though doubtless already much less abundant than in Steller's time, more than a hundred years before. But nowadays it has dwindled to very small numbers, here and there among the Aleutian and Kurile Islands, and these small numbers dwindle more and more every year. I know of no living naturalist who has seen the creature in its haunts, nor has any zoological garden ever possessed it. Once upon a time, by the way, I spent a fortnight on Copper Island, at the north end of which, five or six miles from my hut, was a large rookery of sea-otters; but while I was provided with passports giving me perfect freedom of access to the seal-rookeries, there was no word said about sea-otters; and day after day a polite functionary made excuses and apologies, a Cossack guard made

1 "British Birds' Eggs." By A. F. Lydon. Pp. 62+20 plates. (London: S.P.C K., 1910.) Price 5*s.*

2 "In Forbidden Seas." Recollections of Sea-Otter Hunting in the Kurils. By H. J. Snow, F.R.G.S. Pp. xiv+303. (London: Edward Arnold, 1910.) Price 12*s.* 6*d.* net.

neither the one nor the other, and I came away without ever seeing the sea-otter.

While allied to the ordinary otters, the sea-otter has many peculiarities of structure which have scarcely yet been sufficiently weighed and discussed. Its small, but immensely powerful skull seems disproportionate to its big body; its forepaws are diminutive, while its hind ones are long and almost seal-like; its teeth are unique in their great smooth, rounded crowns, with which the animal crunches the crabs, sea-urchins, and shell-fish that make up most of its diet. Its fur is the finest and richest of all furs, soft, deep, and silky, uniform in colour save for the white or grey head, jet black in the finer skins, or interspersed with silvery hairs in the finest of all. A full-grown animal measures 4 to $4\frac{1}{2}$ feet in length, but the skin of such an animal easily stretches out to 6 feet in length or more, and is worth nowadays something like £300 or £400.

The habits of the sea-otter are very singular. His natural home is on the great beds of "kelp" (Macrocystis), which fringe the rocky coast of the North Pacific, and these great kelp beds make calm water, though the surf be roaring and breaking just outside. The kelp beds are dense enough for the otters to lie upon, and here in old days they were so tame that they used to "stand with head and forepaws out of the water," staring at the hunter and his gun. The creature is handy with its forepaws, and has been again and again described ever since Steller's time as dandling and nursing its young in them; it holds its food almost as a squirrel does, and boxes its young or its companions, like a couple of cats at play. But its hind feet are for swimming only; it walks with difficulty, generally drawing up its hind feet both together and jumping forward, and, as Captain Snow assures us, when it attempts to walk the toes are doubled back under the sole (see illustration).

The mother otter swims upon her back, carrying her pup in her forepaws. When she dives for food she leaves the pup floating on its back, but when chased she dives with it, gripping it by the scruff of the neck, like a cat with its kitten, and she never deserts her pup until the poor little beast is perhaps drowned by her constant diving.

Captain Snow gives us some account of the number of otters killed in the Kuriles, which number between 1872 and 1881 varied from about 300 to 1500 a year. In the next decade (1882 to 1891) about 1200 were taken in all, by both foreign and Japanese schooners; between 1892 and 1901 about 800 were taken, and from 1902 to 1909 only about 350 in all. We may compare these figures with Captain Hooper's statistics for the Aleutian Islands, where more than 58,000 otters were taken in the twenty-four years from 1873 to 1896.

Sea Otter. From "In Forbidden Seas."

But for statistics and other technical details we must go to Hooper and Stejneger, Elliott and Allen, for statistics are not much in our good Captain's line. He is a sailor and an adventurer, and wherever otters were or seals, there was his Treasure Island. He has much to tell and very little to conceal. We hear of his love episodes with this or that young lady whose name ended in San ("it was always happening in those days"), and again of his raids, not bloodless, on Japanese or Russian "rookeries"; for he would seem to have been early aware that "there runs no law of God nor man to the north of *forty-three*." In short, our gallant Captain belongs to a very lovable and all but vanished type, rarer even and better than the sea-otter, the good old delightful breed of the pirate and the robber.

D. W. T.

THE MINNEAPOLIS MEETING OF THE AMERICAN ASSOCIATION.

THE sixty-second meeting of the American Association for the Advancement of Science was held on December 27–31, 1910, at Minneapolis, Minnesota, under the presidency of Dr. A. A. Michelson, of the University of Chicago.

The membership of the association lives for the most part in the large educational and scientific centres of the more eastern States, and, as a result, the large attendance always obtained at Boston, New York, Philadelphia, Baltimore, and Washington could not be expected during the Christmas holidays at a point so far removed as Minneapolis, which, by the way, is about thirty-six hours by rail from New York or Washington. There was, therefore, an attendance of approximately between seven and eight hundred. As often happens, however, with the smaller meetings the interest was quite as keen, if not keener, and the quality of papers presented reached the usual high standard.

At the opening session, held on Tuesday night, December 27, addresses of welcome were delivered by Dr. Cyrus C. Northrop, president of the University of Minnesota, and Mr. Wallace G. Nye, president of the local Chamber of Commerce. President Michelson made an address in reply, after which the retiring president, Dr. David Starr Jordan, president of the Leland Stanford Junior University, delivered his address on "The Making of a Darwin," published in NATURE on January 12. The people of Minneapolis were present in numbers and the audience at this session was very large.

All the meetings were held in the buildings of the University of Minnesota, one of the largest, most progressive and wealthiest of State universities. The handsome and admirably equipped buildings are concentrated in a reasonably compact campus, and no time was lost in going from one section to another. This was in striking relief from conditions existing in previous years. In Boston the meeting places were distributed through Harvard University, Massachusetts Institute of Technology, and Harvard Medical School, all very widely separated.

Apart from the opening meeting, there were only two other general sessions, one devoted to an address by Mr. A. B. Stickney, on the subject, "Should Practical Agriculture and the Physical Development of Childhood be Added to the Curriculum of the City Public Schools?" in the neighbouring city of Saint Paul, on Wednesday night; the other by Mr. William Alanson Bryan, on Thursday night, on the subject of "The Volcano Kilauea."

Probably on account of the distance involved, many of the affiliated societies which customarily meet with the American Association for the advancement of Science met at other cities, but the following were present and listened to excellent programmes:—

American Chemical Society, American Physical Society, American Psychological Association, Botanical Society of America, Botanists of the Central States, Entomological Society of America, American Association of Economic Entomologists, American Federation of Teachers of the Mathematical and Natural Sciences, Association of Horticultural Inspectors, American Mathematical Society (Chicago Section), American Microscopical Society, American Nature-study Society, American Phytopathological Society, Sullivant Moss Society, Western Philosophical Association, American Society of Zoologists (Central Branch).

Following the policy first formulated by the council three years ago, and reiterated by the council this year under formal resolution, the sections of the association, as a rule, did not present long programmes of shorter and more technical papers; but, aside from the addresses of the vice-presidents, devoted their time to the general discussion of topics of broad interest and conducted symposia on four subjects.

The addresses of the vice-presidents (presidents of sections) were as follows:—

A (Mathematics and Astronomy), Ernest W. Brown, Yale University, New Haven, Conn., "The Relations of Jupiter with the Asteroids." B (Physics), Louis A. Bauer, Carnegie Institution, Washington, D.C., "The Broader Aspects of Research in Terrestrial Magnetism." C (Chemistry), William McPherson, Ohio State University, Columbus, Ohio, "The Formation of Carbohydrates in the Vegetable Kingdom." D (Mechanical Science and Engineering), John F. Hayford, College of Engineering, Evanston, Illinois, "The Relations of Isostasy to Geodesy, Geology, and Geophysics." E (Geology and Geography), Reginald W. Brock, Geological Survey of Canada, Kingston, Canada, "Northern Canada." F (Zoology), William E. Ritter, Marine Biological Laboratory, San Diego, California, "The Controversy between Mechanism and Vitalism: Can it be Ended?" I (Social and Economic Science), Byron W. Holt, New York, N.Y., "Causes and Effects of High Land Values." K (Physiology and Experimental Medicine), Charles Sedgwick Minot, Harvard Medical School, Boston, Massachusetts, "The Method of Science."

The principal symposia were as follows:—Section K presented a series of excellent papers by well-known experts on "Disease Due to Filterable Organisms," including two papers on the mysterious Rocky Mountain spotted fever, another on "Acute Anterior Poliomyslitis," and another on "Yellow Fever, Dengue Fever, and Pappataci Fever." In the same symposium, general attention was given to animal diseases, plant diseases, and experimental diseases. The diseases of domestic animals considered were rabies and hog cholera.

Under the Section of Mechanical Science and Engineering, an important symposium was held on the subject of aëronautics, the papers for the most part being technical; but the list included an "Appreciation of Dr. Octave Chanute and His Work in Engineering and Aëronautics," an historical paper on the "Early Attempts to Navigate the Air," a suggested programme of aëronautical research at the colleges, and a paper on "Technical Education in Aëronautics."

Many joint programmes were held between the sections and the affiliated societies. An important conference on botany teaching was held by all of the botanists present, and the question of the water supply of Minnesota was discussed by the geologists. Questions of sewage pollution and the smoky atmosphere of western cities and many other practical topics were discussed in the Section of Chemistry. Section L (Education) joined with the American Psychological Association in discussing general questions relating to school children.

No actions of great importance were taken by the council aside from the resolution looking to the generalising and broadening of the sections and the restriction of purely technical programmes to the affiliated societies.

Two British subjects, and members of the British Association, were in attendance and were made honorary members for the meeting. They were Dr. Marie C. Stopes, of the University, Manchester, and Prof. A. H. R. Buller, of the University of Manitoba.

The general committee designated Washington as the place for the next meeting, with recommendations that Cleveland and Toronto be chosen in the succession indicated for following meetings.

The following officers were elected for the Washington meeting:—

President—Charles E. Bessey, University of Nebraska, Lincoln, Nebraska.

Vice-presidents.—A, Mathematics and Astronomy, Edwin B. Frost, Yerkes Observatory, Williams Bay, Wisconsin; B, Physics, Robert A. Millikan, University of Chicago, Chicago, Illinois; C, Chemistry, Frank K. Cameron, U.S. Department of Agriculture, Washington, D.C.; D, Mechanical Science and Engineering, Charles S. Howe, Case School of Applied Science, Cleveland, Ohio; E, Geology and Geography, Bohumil Shimek, State University of Iowa, Iowa City, Iowa; F, Zoology, Henry F. Nachtrieb, University of Minnesota, Minneapolis, Minnesota; G, Botany, Frederick C. Newcombe, University of Michigan, Ann Arbor, Michigan; H, Anthropology and Psychology, George T. Ladd, Yale University, New Haven, Conn.; I, Social and Economic Science (vacant); K, Physiology and Experimental Science, William T. Porter, Harvard Medical School, Boston, Mass.; L, Education, Edward L. Thorndike, Columbia University, New York, N.Y.

Permanent Secretary.—L. O. Howard, Smithsonian Institution, Washington, D.C.

General Secretary.—John Zeleny, University of Minnesota, Minneapolis, Minnesota.

Secretary of the Council.—Theodore S. Palmer, U.S. Department of Agriculture, Washington, D.C.

Secretaries of the Sections.—A, Mathematics and Astronomy, George A. Miller, University of Illinois, Urbana, Illinois; B, Physics, Alfred D. Cole, Ohio State University, Columbus, Ohio; C, Chemistry, Charles H. Herty, University of North Carolina, Chapel Hill, N.C.; D, Mechanical Science and Engineering, George W. Bissell, Michigan Agricultural College, East Lansing, Mich.; E, Geology and Geography, F. P. Gulliver, Norwich, Conn.; F, Zoology, Maurice A. Bigelow, Columbia University, New York, N.Y.; G, Botany, Henry C. Cowles, University of Chicago, Chicago, Illinois; H, Anthropology and Psychology, George Grant MacCurdy, Yale University Museum, New Haven, Conn.; I, Social and Economic Science, Fred C. Croxton, 1229 Girard Street, Washington, D.C.; K, Physiology and Experimental Medicine, George T. Kemp, 8 West 25th Street, Baltimore, Maryland; L, Education, Charles Riborg Mann, University of Chicago, Chicago, Illinois.

Treasurer.—R. S. Woodward, Carnegie Institution, Washington, D.C.

SCIENCE AND POTTERY.[1]

THE English Ceramic Society, founded about ten years ago, had its origin in a belated attempt, made by a few enlightened manufacturers, to introduce scientific method into the conduct of one of our most important industries. There is a proverbial connection between the potter and his thumb, and in no other leading manufacture in this country is the rule of thumb so dominant or so repressive as it is in that of pottery. The ceramic art as practised in England is for the most part empirical, and is therefore highly conservative; changes are few and progress is correspondingly slow. At the same time, in certain respects, the industry has reached a high degree of mechanical perfection. English china is a product *sui generis*, and its merits are widely recognised, even by those who decline to regard it as a variety of porcelain. In the manufacture of the highest qualities of earthenware no nation has hitherto surpassed us. But signs are not wanting that our supremacy is challenged, and each succeeding decade sees the struggle becoming more and more acute. The industry is, in fact, between the upper and the nether millstones of conflicting tariff systems. Industrial conditions in the Potteries are, in some respects, without parallel in any other manufacturing district. In no other staple trade of like magnitude is to be found so numerous a class of small manufacturers—persons of little or no capital and employing few hands—some of them no more than the members of their own families. These are for the most part ignorant of anything beyond the ordinary technique of their art. Even in the case of larger concerns, it was, until of late years, rare to meet with any evidence of practical recognition of the scientific principles underlying the industry. Such a condition of things cannot possibly tend to development in the art itself, or to improvement in the welfare of the workers engaged in it.

Ceramics is a branch of applied chemistry and physics, of chemical engineering in its most comprehensive sense. That this fact is beginning to be slowly appreciated may, we think, be inferred from the gradual increase in the number of the members of the English Ceramic Society. The society started in 1900–1 with 29 members; in 1909–10 its numbers were 261, but of these, it ought to be said, a certain fraction are engaged in American and Continental factories. But, after all, this growth in numerical strength is hardly commensurate with the value and importance of the society's objects, or with the influence it may be expected to exercise upon the development of the industry with which it is concerned. In the United Kingdom there are some 550 potteries; of these 329 are concentrated in the group of towns known as the North Staffordshire Potteries. It is not unreasonable to expect that in the case of an institution centrally situated and in close proximity to Burslem, Fenton, Hanley, Longton, and Tunstall, there would, after ten years of existence, be a membership equal at least to the number of factories in the neighbourhood. That such is not the case is only one more instance of the supineness and indifference of our manufacturers, as a class, to the bearing of physical science, its methods and its teaching, upon their industries.

Of the general character of the twenty-two contributions to the scientific work of the society contained in this volume we have nothing but commendation to offer. They all bear directly on problems of practical interest to the potter. The papers of Mr. Fowler on the control of kiln and oven gases; of Messrs. Cobb and King on the fluxing power of the common oxides; the papers by Dr. Mellor on cylinder grinding, vitrification of clays, surface factors, softening temperatures of lead silica glazes, and the two excellent papers by Mr. Thomason, on the toxic possibilities of fritted lead glazes and on white lead and plumbism are of permanent value as additions to ceramic literature. The latter papers are of special interest at the moment in relation to the question of lead-poisoning in pottery manufacture. Mr. Thomason points out that the official returns from such factories as are working under the 5 per cent. standard of solubility, as defined by the method prescribed by Sir Edward Thorpe, and adopted in the Home Office special rules, show no cases of plumbism amongst workers in the prepared glazes, and that the information available from the Continent is to a similar effect. It has been objected to this method that it bears no real analogy to what actually goes on in the human system. Mr. Thomason effectually meets this objection. After a careful experimental inquiry of which full details are given in the papers, and in which, so far as possible, all the conditions known to occur in the animal body were separately and collectively studied, Mr. Thomason concludes that the solubility of a glaze in the stomach is properly gauged by the official method, and that the figures so obtained are fair statements of its toxic possibilities.

These papers were evidently not very pleasant hear-

[1] Transactions of the English Ceramic Society. Vol. ix. Session 1909–10 (Stoke-on-Trent, Staffordshire: Published by the Society; Longton: Hughs and Harber, Ltd., 1910.)

ing to at least one member of the Ceramic Society, and were somewhat carpingly criticised by Mr. Bernard Moore, a representative of the manufacturers on the late Departmental Committee. How Mr. Thomason effectually disposed of Mr. Moore in the course of the subsequent discussion, will be evident to any unprejudiced reader.

It is not to be expected that in such a journal as we are noticing there would be much reading *pour rire*. But in the concluding paper, which tells of a visit paid by the society to a white-lead works, where the members seem to have been most hospitably entertained by the proprietors, there is a very distinct flavour of comedy. After the luncheon, one of the senior members of the party made an attempt to express the gratitude of the society to their quondam hosts. Unfortunately the speaker had evidently been much perturbed by the sight of a lavatory basin marked "leadless glaze," and this untoward circumstance, combined with the influence of "a sumptuous table" from which the party "had almost succeeded in abolishing that 'dangerous element,' water," led him to make an ill-mannered and vituperative attack upon what he was pleased to call "a band of faddists who had little better with which to occupy their meddlesome minds" than to bring down upon the trade "a perfect plague of inspections, committees, arbitrations, and commissions." But the orator took heart of grace. He did not despair "so long as they had such friends as *Mr. Bernard Shaw* on the Lead Commission." Mr. Shaw is as ubiquitous as King Charles's head, but it is a little hard on him to confound him with Mr. Bernard Moore, with whom he has little in common. The sorry thing is that the silly speech reflects the attitude of a not inconsiderable section of the manufacturers to what is a great and crying evil in their industry.

AN INSTITUTE OF HUMAN PALAEONTOLOGY.

THE Prince of Monaco, as is well known, is a scientific man of high attainments, more especially in the sphere of oceanography. His own researches and those conducted under his auspices have been of first importance. A short time ago an account was given in these columns of the beautiful and well-equipped Museum of Oceanography which he erected at Monaco, and in last week's NATURE (p. 379) mention was made of the Oceanographical Institute founded and endowed in Paris by the Prince. As stated in another column, the institute was inaugurated on Monday, January 23, and it is hoped to give an account next week of the opening.

In 1872 M. Émile Rivière discovered the first Palæolithic skeletons of the Baoussé-Roussé caves ("The Red Caves") or Grimaldi caves, as it was decided they should be called at the International Congress of Anthropology and Prehistoric Archæology at Monaco in 1906. Later investigations revealed fresh remains, and the Prince himself in 1907 discovered the fourth grave, that of the two famous "Negroids." The Prince took great interest in these important discoveries, and generously assisted in the work which was mainly conducted by the Canon de Villeneuve, Profs. Boule, Verneau, and Cartailhac. A great deal has been written on these finds in various journals, and the official reports have been published by the Prince in two volumes; he has also established a Museum of Archæology at Monaco. The Prince was so much impressed by the wonderful mural engravings and frescoes of Palæolithic age which adorn so many caves in central and south France and north Italy that he commissioned Dr. Émile Cartailhac and l'Abbé H. Breuil to make a thorough investigation of them, which, with his customary munificence, will be published in a series of sumptuous monographs, of which the first "La Caverne d'Altamira à Santillane près Santander (Espagne)," has recently appeared. In the current number of *l'Anthropologie* (tome xxi., p. 725), it is stated that the Prince has decided to found in Paris an institute of human palæontology. In a letter to the Minister of Instruction announcing his decision he says that he has come to feel that greater prominence should be given to the study of the mystery which shrouds the origin of mankind, and that a methodical basis of archæological investigation is required. "Et je pensais que la philosophie et la morale des sociétés humaines seraient moins incertaines devant l'histoire des générations, écrite avec leur propre poussière." Having seen that oceanography was fittingly domiciled in Paris and Monaco, he gave some attention to the requirements of human palæontology.

The Prince goes on to state his intention of founding in Paris a centre for the pursuit of studies based on systematic excavation. The site for the institution has been selected, and the staff and a financial board of management appointed. The munificent founder adds that he has endowed the "Institut de Paléontologie humaine" with the sum of 1,600,000 francs, and proposes to make over his collections to it conditionally. The Prince, desirous of securing the most favourable terms of existence for this foundation, begs the Government to recognise its value and approve its statutes. A. C. H.

NOTES.

THE death of Sir Francis Galton at Grayshott House, near Haslemere, on January 17, marks another link broken with the greater leaders of nineteenth-century science. Sir Francis passed away quietly after only a few days' illness, clear in mind, and able within a few hours of his death to question his physician humorously as to the statistics available for the reputed action of strychnine as a drug. By his own desire his body was interred at Clavendon, near Warwick, a peaceful country churchyard, close to the house which had once been the home of his mother (Violetta Darwin), and still remains a spot with much of artistic interest to those who value the family history of a noteworthy scientific stock. The funeral took place an Saturday, January 21, the Master of Trinity College (representing the University of Cambridge and the college) and the vicar of Clavendon taking the service. Among the relatives and friends present were Miss E. Biggs, Mr. and Mrs. E. G. Wheler, Father Charles Galton, S.J., Major Hubert Galton, Miss Violet Galton, Mrs. Moilliet, Major Guy Lethbridge, Mr. Geoffrey Butler, Mr. A. F. G. Butler, Charles Galton Darwin, Miss A. Jones, and Prof. K. Pearson. The Royal Society was represented by Sir George Darwin and Mr. William Bateson, the former also representing the Royal Meteorological Society; Prof. A. Dendy represented the University of London and King's College; Major Leonard Darwin, the Royal Geographical Society; Dr. Charles Chree, the Kew Observatory; and Dr. David Heron, the Galton Eugenics Laboratory. We hope next week to publish some account of Sir Francis Galton's life and work.

THE two principal candidates for the vacant seat in the Paris Academy of Sciences caused by the death of M. Gernez were Mme. Curie and Prof. E. Branly. At the meeting of the academy on Monday, January 23, Prof. Branly was elected to the vacancy by the narrow majority of two votes. In the first ballot he received 29 votes against 28 given to Mme. Curie, and in the second 30

votes were given to him, while Mme. Curie received the same number as before. We congratulate Mme. Curie upon the substantial support she secured, and trust that before long her claims to a seat in the academy will receive their rightful recognition. The narrow margin by which she lost election on Monday may, we suppose, be taken to mean that the academy is about equally divided as to the eligibility of women for membership, and that Mme. Curie may expect to be elected on a future occasion. As scientific work must ultimately be judged by its merit, and not by the nationality or sex of its author, we believe that the opposition to the election of women into scientific societies will soon be seen to be unjust and detrimental to the progress of natural knowledge. By no pedantic reasoning can the rejection of a candidate for membership of a scientific society be justified if the work done places the candidate in the leading position among other competitors. Science knows no nationality, and should recognise no distinction of sex, colour, or creed among those who are contributing to its advancement. Believing that this is the conclusion to which consideration of the question must inevitably lead, we have confidence that the doors of all scientific societies will eventually be open to women on equal terms with men.

The inauguration of L'Institut Océanographique de Paris took place on Monday evening, January 23, in the presence of the President of the Republic, M. Fallières, and a distinguished gathering, presided over by his Serene Highness the Prince of Monaco as president of the council of administration. Among those present were Prince and Princess George of Greece, Prince Louis of Monaco, Prince Roland Bonaparte, ex-President Loubet, the members of the Government, Ambassadors and Ministers Plenipotentiary of the foreign Powers, and the members of the Conseil d'Administration and Comité de Perfectionnement, including, among others, Dr. Paul Reynard, director of the institute; Dr. Jules Richard, director of the museum at Monaco; Prof. Chun, of Leipzig; Prof. Hergesell, of Strassburg; M. Thoulet, of Nancy; Sir John Murray, K.C.B., F.R.S.; Mr. J. Y. Buchanan, F.R.S.; and Dr. W. S. Bruce. Short addresses were delivered by the Prince of Monaco; M. Maurice Faure, Minister of Public Instruction and Fine Arts; M. Armand Gautier, president of, and in the name of, the Academy of Sciences; M. Liard, vice-rector of, and in the name of, the University of Paris; and M. Perrier, director of the Museum d'Histoire naturelle. M. Henri Bourée, *aide-de-camp* to the Prince of Monaco, also showed some excellent lantern illustrations and kinematograph views of the Prince's oceanographical investigations on board the *Princesse Alice*. After the formal proceedings, the assembled company proceeded to inspect the institute, an account of which, with its aims and object, will appear in a subsequent issue.

Sir Joseph Larmor, F.R.S., Lucasian Professor of Mathematics at Cambridge and secretary of the Royal Society, has accepted the invitation of a meeting of the Unionist Party to become the Unionist candidate for the vacancy in the Parliamentary representation of Cambridge University. The prospect which this selection offers of including among the members of the House of Commons a man of distinguished eminence in the scientific world, is especially gratifying, in view of the necessity of keeping before the Government and the legislature the need for a general adoption of the methods of science in the affairs of the Empire. It is refreshing to find the value of scientific progress given prominence in an election address. Sir Joseph refers in his address to the progress of scientific knowledge during the last half-century, and to the part which Cambridge has played in promoting the advancement of this newer learning. He adds:—"But modern scientific discovery advances with accumulated force: better organisation and knowledge, in order to take full advantage of the resources that are available for this country, is still one of our foremost problems in the face of the competition of other nations; and our University is destined for an even wider sphere of work and influence than has fallen to us in the past. It should be our aim to supply leaders of industry who possess not only special attainments, but also that temperament of scientific inquiry which exalts industrial pursuits and is the most potent influence for their progress."

According to a statement issued to the Press by Mr. William Willett, the originator of the so-called Daylight Saving Bill, the Home Secretary, Mr. Winston Churchill, "cannot conceive of any argument now which would cause him to doubt the wisdom of passing the Daylight Bill into law." Mr. Churchill is therefore prepared to make a speech in favour of the Bill when it comes again before the House of Commons. He considers that as agriculturists form only about eight per cent. of the population, their objections may be disregarded, "in order to bring within the reach of the other ninety per cent. of the population the blessings of sunlight and fresh air in their leisure hours." Mr. Churchill is, in fact, prepared to support a measure which will convert Greenwich time into German time at stated intervals, not because he has taken competent opinion as to the consequences of such an Act, but because he thinks a majority desires it. In the building and engineering trades, and in the Government's own dockyards, the working hours are already adjusted to the seasons, without legislative interference, so that the suggestion that agriculturists are the only people who do not want the Bill is altogether misleading. The daylight effects of the difference in latitude between London and Edinburgh are apparently not to be considered in these days of hasty and unnecessary legislation. Consideration of these effects would show at once that North Britain should be excluded from the provisions of the Bill. The promoters of the Bill refer to the advantages which would be obtained by altering the hours of work at different seasons of the year according to those of daylight. But it does not seem to occur to them that all the advantages could be secured in a much simpler way without the indescribable confusion and inconvenience which would be caused by frequent interference with clock-time. We believe that if the measure which Mr. Willett persistently puts forward is ever put upon the statute book, it will make us the laughing-stock of the civilised world. Unable to change our customs, we are to deceive ourselves into doing so by moving the hands of clocks in months prescribed by Act of Parliament. Such methods may be appropriate for lodging-house servants, but they are unworthy of the dignity of a great nation. It is peculiarly unfortunate that a Cabinet Minister should permit his name to be used in connection with such a proposal at the present time, seeing that a Bill to make Paris official time coincide with Greenwich time has been approved by the French Chamber of Deputies, the Senate Committee and the Cabinet, and will in all probability become law. We cannot believe, in the face of such facts, that Parliament will entertain seriously the proposed periodic change of our time-standard which Mr. Churchill is said to regard with favour.

The concluding part (No. 10) of last year's volume of the *Kew Bulletin* contains identifications of new Lauraceæ

by Mr. J. S. Gamble, new orchids by Mr. R. A. Rolfe, and a new genus of Leguminosæ, Leptoderris, by Mr. S. T. Dunn. The new genus is practically a segregate from Derris, which it resembles in fruit, and comprises fourteen species, all derived from tropical Africa. An article by Mr. W. J. Bean provides a fourth set of garden notes on new trees and shrubs. An Alpine variety of *Erica arborea* is noted for its hardiness. Chinese introductions include *Acer griseum*, a striking trifoliate maple, *Berberis parvifolia*, a distinct species, and *Sarcococca ruscifolia*, a euphorbiaceous evergreen with habit recalling Butcher's broom. Two illustrations depict *Fothergilla major*, an American shrub highly decorative when in flower, and *Pistacia chinensis*.

THE starting of the Australian Antarctic Expedition seems now assured by the subsidies promised by the Australian Association for the Advancement of Science. The expedition will be under the command of Dr. Mawson, and it will enter the Antarctic field which now promises the most useful results. Many attempts have been made to discredit the existence of Wilkes Land, and it is obvious that Wilkes reported land farther to the north than it exists; nevertheless, his narrative offers convincing evidence that his expedition met land in that part of the Antarctic region. The Shackleton expedition has proved the extension of the land further west from Cape Adair than any other expedition, and Dr. Mawson proposes to follow this coast-line further to the west, which was one of the unfulfilled parts of the programme of the *Discovery* expedition. The German Antarctic Expedition, under Prof. von Drygalski, established the existence of continental land south of Kerguelen. No accessible part of Antarctica offers such promising results as that selected by Dr. Mawson. The development of wireless telegraphy has already led to the suggested establishment of an Australian meteorological station on that part of the Antarctic coast, and this observatory may be hoped for ultimately.

FOREIGN newspapers announce several losses that various scientific institutions have just sustained by the death of members on their respective staffs. Foremost among these is M. Gustave Leveau, by whose death the Paris Observatory loses its oldest official, who for more than half a century participated in its work and shared its renown. He had served under Le Verrier, Delaunay, Mouchez, Tisserand, Lœwy, and Baillaud, a long list recalling the various changes in the direction of activity pursued at the national observatory. M. Leveau, who rendered important services in various departments of celestial mechanics, will be best remembered for his researches into the motion of the comet of D'Arrest, the perturbations of which he regularly calculated, and at each return prepared an ephemeris. He belonged to the school of Le Verrier, and his tables of Vesta and other researches show the effect of his master's influence. Notwithstanding his mathematical work, he gave assiduous attention to the routine of the observatory, taking part mainly in the meridian observations. The director of the Leipzig Observatory announces the death of F. W. Hermann Leppig, who since 1867 has worked strenuously to forward the interests of that institution. The work of the deceased astronomer was mainly confined to meridian observations, time distribution, and in the meteorological service. The death of M. Rozé, astronomical lecturer at the Ecole Polytechnique and professor of mathematics in the Ecole de physique et chimie, is also announced. Since 1859 he had been attached to the Ecole Polytechnique, and for more than forty years had taken part in the tutorial work.

THE conference on sleeping sickness recently held at the Foreign Office was convened, Reuter's Agency learns, by the British Government as a result of representations made of the danger of the spread of sleeping sickness in consequence of the construction of the Rhodesia-Katanga Railway, which runs from the north of Broken Hill to the Congo frontier and beyond. The delegates to the conference were M. Melot, representing the Belgian Government, Dr. van Campenhout, of the Colonial Office in Brussels, Dr. Sheffield Neave, representing the Rhodesia-Katanga Railway, Dr. Aylmer May, representing the Chartered Company, Dr. Bagshawe, of the Sleeping Sickness Bureau, and representatives of the British Foreign and Colonial Offices. As the result of its deliberations, the conference concluded, with regard to the necessary precautions in the case of new railway extensions, that it is essential that the route of these lines should be inspected for *Glossina palpalis*, that maps of the fly areas be prepared, that railways should cross the fly belt at the narrowest points and not follow them, that there shall be no station, buildings, or stopping-places in the *G. palpalis* area, and that labourers on the railways should be recruited under such condition as to avoid infection. During the working of railways, it is recommended that there shall be constant supervision and inspection, that passenger carriages, trucks, &c., shall, so far as possible, have openings covered with fly-proof gauze, and that as *G. palpalis* probably does not exist south of the Congo-Zambezi watershed, the Rhodesia-Katanga Railway shall be worked in two sections with the view of avoiding the possibility of carrying the fly from one area to another.

MR. C. B. HOLMAN-HUNT, curator of the Selangor Museum, has been appointed assistant entomologist in the agricultural department of the Federated Malay States.

WE learn from the *Revue scientifique* that Baron Reinach has provided the Frankfort Physical Society with the funds necessary to establish a seismological observatory on the Feldberg, in the Taunus range. Dr. F. Linke will be the director of the observatory.

THE Belgian Royal Academy of Sciences, Letters, and Arts has awarded to Dr. L. A. Bauer the Charles Lagrange Prize for the period 1905–8, of 1200 francs, on account of his various researches in terrestrial magnetism. The academy has also awarded the decennial prize of 5000 francs for researches in physics and chemistry to M. Van der Mensbrugghe, for his work on the molecular physics of liquids.

ACCORDING to the *Revue scientifique*, the Krupp Society has given Prof. Emil Wiechert, of the University of Göttingen, 10,000 marks to enable him to conduct experiments in aërodynamics; and also 6000 marks to Prof. Leopold Ambronn, of the same university, for the construction of a new photographic apparatus.

THE Geological Society of London will this year award its medals and funds as follows:—Wollaston medal, Prof. Waldemar C. Brögger; Murchison medal, Mr. R. H. Tiddeman; Lyell medals, Dr. F. A. Bather and Dr. A. W. Rowe; Bigsby medal, Dr. O. Abel; Wollaston fund, Prof. O. T. Jones; Murchison fund, Mr. E. S. Cobbold; and the Lyell fund, Prof. C. G. Cullis and Mr. J. F. N. Green.

The second annual Simple Life and Healthy Food Conference and Exhibition will be held in the Caxton Hall, Westminster, on March 21–24. The objects of the conference and exhibition are to simplify modern life, to introduce into homes healthy food and hygienic decorations, to teach rational physical culture, and to inculcate a love of simple and beautiful architecture.

Announcement is made of another gift of 2,000,000*l.* presented by Mr. Carnegie to the Carnegie Institution at Washington. It is stated that Mr. Carnegie's total gifts to that foundation amount to 5,000,000*l.*, and his total benefactions to nearly 40,000,000*l.* The gift from him is also announced of a new telescope, with a 100-inch lens, for the observatory on Mount Wilson, California.

At a meeting of the executive committee of the British Science Guild, the question of the annual dinner was considered in connection with the visit of the Colonial Premiers for the Imperial Conference of the Colonial Premiers. It was stated that the report on the synchronisation of clocks had given rise to a very wide discussion by the newspapers and Press. A committee was appointed to deal with the question of the prize essay upon the best way of carrying on the struggle for existence and securing the survival of the fittest in national affairs.

The announcement has been made of the discovery of the ancient fossil Archæocyathus in material collected in Antarctica by the Shackleton expedition. The identification was made some months ago by Dr. Griffith Taylor, who is the author of a monograph on the Archæocyathineæ of South Australia, and is a member of the present British Antarctic Expedition. As Archæocyathus was a marine animal, it, of course, does not supply any evidence bearing on the presumed land connection between Australia and Antarctica. The evidence for that hypothesis is based on the distribution of land animals in the southern hemisphere and on tectonic evidence.

According to a Reuter message from San Francisco, Mr. Eugene Ely succeeded, on January 18, in an attempt to fly in a Curtis biplane from Selfridge Field, twelve miles south of San Francisco, and to land on the deck of the cruiser *Pennsylvania*, lying twelve miles from the coast. Shortly afterwards he returned in his aëroplane to the starting point. The flight was made close to the water, and the aëroplane approached the cruiser's bows. Mr. Ely flew past the ship for a distance of about a hundred yards, and then circled back, rising slowly, and finally settled lightly. The flight occupied sixteen minutes going and fifteen minutes returning.

At the Royal College of Surgeons on February 1 Dr. F. W. Edridge-Green will deliver the first of two lectures on "Colour-vision and Colour-blindness." The second lecture will be given on February 3. Two lectures will be delivered by Prof. W. d'Este Emery on "The Immunity of Reaction in Relation to Surgical Diagnosis" on February 6 and 8, and on February 10 Prof. Benjamin Moore will give one lecture on new views on the chemical composition and mode of formation of renal calculi, and the metabolism of calcium in gout. Prof. G. Elliot Smith, F.R.S., is to give three lectures on "The History of Mummification" on February 13, 15, and 17. The conservator of the college museum, Prof. Arthur Keith, will deliver lectures on "The Anthropology of Ancient British Races" on February 20, 22, 24, and March 1 and 3.

A contractor employed by the Okehampton Rural District Council for the repair of roads recently removed stones from an ancient monument, known as King's Oven. Attention having been directed to this action, the Council, while admitting that the contractor should not have removed the stones, suggested that the Duchy of Cornwall should bear the cost of restoring the stones. The Secretary and Keeper of Records of the Duchy has informed the District Council that in future permission to take stone must be obtained before it is used for road mending, and that the Duchy counts upon the support and assistance of the local authorities in the protection and preservation of ancient remains. The District Council has, we are glad to know, decided to take steps to replace the stones.

The annual general meeting of the Royal Meteorological Society was held on January 18. After the report of the council had been read, the president, Mr. H. Mellish, said that the completion of the third decade since the society undertook the collection of climatological observations suggested that the moment was opportune for taking stock of the data which had been collected in the British Isles, and of the progress which has been made in reducing and discussing them; he therefore devoted his address to a consideration of the present position of British climatology. The following officers were elected for the ensuing year:—*President*, Dr. H. N. Dickson; *vice-presidents*, F. Druce, H. Mellish, R. G. K. Lempfert, Colonel H. E. Rawson, C.B.; *treasurer*, Dr. C. Theodore Williams; *secretaries*, F. C. Bayard, Commander W. F. Caborne, C.B.; *foreign secretary*, Dr. R. H. Scott, F.R.S.

The *Northern Whig* for January 19 contains a full report of a meeting held by the Belfast Naturalists' Field Club to commemorate the life-work of the late Samuel Alexander Stewart. The Rev. C. H. Waddell, Mr. R. Lloyd Praeger, and the president of the club, Mr. R. J. Welch, dwelt on various aspects of Stewart's career. Mr. Waddell and Mr. Praeger have also contributed sympathetic notices, accompanied by a bibliography and a charmingly characteristic portrait, to the *Irish Naturalist* for October, 1910. Belfast is justly proud of having numbered Stewart among her citizens for more than seventy years. It is one of the ironies of fate that his death, at the age of eighty-four, was caused by a street accident, but he had already retired from his post at the museum of the Belfast Natural History Society. His career was outlined in Nature for June 30, 1910, and the recent meeting shows that the impression made by the energy and temperament of the man will not be lost among naturalists in Ireland. Those who knew his welcoming smile, and who discussed with him questions of botany or geology, felt that they were in the presence of a mind as beautiful as the open-air studies to which he pointed out the way.

Proceeding upon the reports of three committees and a Royal Commission, Mr. J. C. Medd presents in the *Quarterly Review* (January) a rational criticism of ways and means with reference to the extension of forestry areas and improved methods of cultivation in the British Isles. As examples of small beginnings, allusion is made to the purchase of the Inverliever estate in Argyllshire, of a forestry station at Avondale, and of estates at Aghrane, Dundrum, and other localities in Ireland. In common with most critics, Mr. Medd comments upon the failure of the commission to consider a scheme of cooperation between the State and private owners, and instances a number of advantages that would attend such an arrangement; in this connection he mentions approvingly the scheme of copartnership advocated by Lord Lovat. With regard to difficulties in the way of an extensive general scheme, it is pointed out that it would be unwise to dis-

place remunerative sheep farms and sporting estates by prospective forests of unknown value. The author touches on the need for information with respect to cost of plantations, facilities for training woodmen, and the possibilities of turning nature-study classes in the country schools to practical advantage. Cognate to the subject of the article is the announcement, last week, of the formation of an English Forestry Association, with Lord Clinton as the first chairman, for the purpose of organising the market for English timber, encouraging its use, and assisting in the establishment of local wood industries in suitable districts.

THE annual meeting of the Entomological Society of London was held on Wednesday, January 18, when the officers and council for the forthcoming session, 1911–2, were elected. Owing, however, to the death of Mr. J. W. Tutt, the president-nominate, no successor to the outgoing president, Dr. F. A. Dixey, F.R.S., was chosen, and a special general meeting will be held later in the year for that purpose. Meanwhile, the following fellows were elected to act as officers and members of the council:—*Treasurer*, Mr. A. H. Jones; *secretaries*, Commander J. J. Walker and (in place of Mr. H. Rowland-Brown, who resigns after eleven years' service) the Rev. G. Wheeler; *librarian*, Mr. G. C. Champion; *other members of the council*, Mr. R. Adkin, Mr. G. T. Bethune Baker, Prof. T. Hudson Beare, Dr. M. Burr, Dr. F. A. Dixey, F.R.S., Mr. H. St. J. Donisthorpe, Mr. J. H. Durrant, Prof. Selwyn Image, Dr. K. Jordan, Mr. A. Sich, Mr. J. R. le B. Tomlin, and Mr. H. J. Turner. The president, in the course of his address, dealt with certain problems of general biology on which special light had been thrown by entomological study, notably the demonstration that permanent races, differing from the parent stock, could be produced by artificial interference with the germ-plasm. This had been surmised from early experiments of Weismann, followed by Standfuss and Fischer, and had now been placed beyond doubt by the careful work of Tower in America, who had also shown that the new form might stand in Mendelian relation with the stock from which it sprang. Other topics touched upon in the address were the psychophysical character of the material presented to the operation of natural selection, a point particularly emphasised by Prof. Mark Baldwin, and, in connection with this, the special interest attaching to the communities of the social Hymenoptera, where the group rather than the individual appeared as the unit of selection.

A FORM of treatment of wasting diseases of young children has been recently introduced by M. Quinton. It consists in the injection every second day of 10–30 c.c. of pure fresh sea water, sufficiently diluted with distilled water so that the mixture is isotonic with human blood. Considerable success is claimed for this treatment, and, according to the *Morning Post* of January 16, M. Quinton lately visited London in order to arrange for the establishment of a dispensary for the trial of his method.

WITH the December (1910) number, the *Journal of Hygiene* completes its tenth volume, and contains indexes of authors and of subjects to the ten volumes issued, in addition to several important papers. Messrs. Glenny and Walpole find that vulcanised rubber has the power of absorbing mercury biniodide and mercuric chloride from weak solutions, in some cases almost completely. Dr. Peters in an elaborate paper discusses the natural history of epidemic diarrhœa, one of the most important conclusions being that the milk supply plays little or no part in its propagation, and that boiling the milk gives no protection.

ACCORDING to a note in the *Times* last week, plague-infected rats are still being met with in Suffolk and over an extended area, and for the purpose of aiding the Local Government Board in this connection, the Lister Institute has detailed two bacteriologists for work in the district. It would be well if the authorities followed the example of the United States Government in its campaign against the ground squirrels in California as described by Surgeon McCoy in the December (1910) number of the *Journal of Hygiene* (x., No. 4, p. 589). The squirrels are infected with plague, and during 1909–10 150,000 of the rodents were examined. The necessity for investigations on a large scale is apparent when it is stated that in one county more than 8000 squirrels were examined before any infection was discovered.

IN vol. xxiii., No. 4, of Notes from the Leyden Museum Dr. E. D. Van Oort describes, under the name of *Anurophasis monorthonyx*, a new genus and species of game-bird, obtained with other new birds, during the expedition of Mr. H. A. Lorentz to south-western New Guinea. The genus name relates to the apparent absence of tail feathers. It is not stated to what group the new bird is related. Dr. Horst's description in this issue of a new peripatus obtained during the same expedition has been noticed already in NATURE.

FROM a study of the local myriopods of the group Diplopoda (Chilognatha), Dr. K. W. Verhoeff, in a paper contributed to the *Abhandlungen der naturwiss. Ges. Isis* for the first half of 1910, considers himself justified in dividing Germany into three zoological provinces, from north to south, which he calls north, central, and south Germany. Central Germany is further split into two sub-provinces, from west to east, which are termed west central and east central. Details of the distributional grounds on which these divisions are based will be found in the paper, but it may be noted that the distribution of many groups of Diplopoda corresponds very closely with that of particular geological formations.

ACCORDING to an article contributed by Messrs. De Drorein de Bouville and Mercier to the *Revue générale des Sciences* for December 30, 1910, there has been a great recrudescence and expansion on the Continent during the past year of the salmon-disease known in France as furonculosis. The disease, which attacks both salmon and trout, together with a few other fishes, such as pike and carp, has been known on the Continent for about a quarter of a century, and was carefully studied at Munich in 1888 and the two following years. In June of last year the disease became more than usually prevalent, especially in Bavaria, where it made its appearance for the first time in 1909, and this recrudescence has given rise to much anxiety on the part of all connected with fresh-water fisheries. The disease, of which the symptoms are fully described in the article, is caused by the bacillus known as *Bacillus salmonicida*, but whether it was originally imported from America, or whether it be due to a pathogenetic development of a native organism, the authors leave an open question. It is noteworthy that rainbow-trout are particularly susceptible to furonculosis, which is fatal to a large percentage. This being so, the authors recommend that the practice of stocking European rivers with exotic salmonoids, which are generally in a low state of vitality, and therefore prone to take disease, should be discouraged. On the other hand, efforts should be made to restock salmon and trout streams with native stock, which is the most fitted to adapt itself to local conditions, and, further, that such fish should not be reintroduced into rivers from which they have completely dis-

appeared, as the causes which have led to the extinction are probably still active. Whether the continental *Bacillus salmonicida* is identical with the British *B. salmonis pestis*, Patterson, is not stated in the article.

THE annual volume for 1910 of the *Bulletin of Miscellaneous Information*, issued from the Royal Botanic Gardens, Kew, has now been published at the price of 4*s*. 6*d*. Attention has been directed already in these columns to the papers in separate numbers of the *Bulletin*, and it is sufficient to say here that the volume contains ten numbers, four appendices, and a complete index.

A LIST of Siamese plants compiled by Dr. C. C. Hosseus, and published in the *Beihefte zum Botanischen Centralblatt* (vol. xxvii., part ii.), represents, as the author points out, merely a contribution to the flora of Siam, inasmuch as some of the provinces are entirely unexplored. The author has received valuable help from many botanists in the identification of his specimens, and has furnished indications of the regions from which each species was obtained. The list shows a preponderance of Leguminosæ and Cyperaceæ.

THE latest part (vol. iv., No. 4) of the Records of the Botanical Survey of India is devoted to the notes contributed by Mr. I. K. Burkill with reference to a journey into Nepal. The author collected few novelties—three species of Impatiens and an Eriocaulon—which is explicable, as he traversed nearly the same route at the same season of the year that Wallich took eighty-seven years earlier. The notes relate chiefly to detailed features of the vegetation and a comparison of the sál, *Shorea robusta*, forests and flora of the hill tops in Nepal with those in Sikkim.

MR. ASKIN NICHOLAS, writing from 31 Queen Street, Melbourne, advances a curious explanation of Glacial periods of geology. He suggests that "the Glacial period corresponds with the period in which the moon lost its water. To me it seems feasible that this would be annexed by our planet by first forming a ring around it, under which *ring* would be a perpetual shadow of great width." But Mr. Nicholas's suggestion would not explain either the geographical distribution of areas of heavy glaciation or the recurrence of such glaciations. Mr. Nicholas refers in the course of his letter to the Glacial periods, and thus recognises that there have been more than one; and the last was geologically so recent that it would seem most improbable that there should have been any important change in the condition of the moon since that date. If the suggestion were valid, the moon should also have lost its water once during pre-Cambrian, in Cambrian, and Carboniferous times. Mr. Nicholas will find a discussion of the supposed causes of glaciation in Chamberlin and Salisbury's "Geology," vol. iii., 1906, pp. 424–46.

La Nature for December 17, 1910, contains a photograph of the "Spectre of the Brocken," taken some time ago by M. Th. Moureaux on the terrace of the observatory of the Pic du Midi. It shows in the centre of the corona the shadow of the operator holding up the photographic apparatus. On the summit of the peak and to the westward patches of cumulus cloud were scattered over the sky, and at times the sun shone out brightly on the rising mists. The author of the note (M. J. Loisel) states that, so far as he knows, this is the first time that the spectre has been photographed. He refers to M. Lancaster's experience at Uccle at the time of a thick fog in July, 1892, during which he saw his shadow projected by a lamp burning in a room on the second floor, and all his movements reproduced. M. Loisel remarks that it would be interesting to observe whether the phenomenon would be repeated in any thick fog, or only under special conditions.

WE have received a catalogue of physical apparatus and optical goods from Messrs. R. and J. Beck, which contains a longer list of parts of optical apparatus, *e.g.* lenses and prisms of glass or quartz, than we have seen previously in any English catalogue. It will prove of great help to those who are constructing apparatus for special purposes. The most noteworthy larger pieces of apparatus described are a lens-testing bench with all the fittings requisite for the rapid examination of spectacle lenses, and a large optic bench for interference and diffraction observations, which Messrs. Beck have made into a universal instrument by providing it with a spectrometer to fit on to one of the upright pillars, and with the lenses and polarising prisms necessary for the optical examination of crystals.

A COPY of the "Instructions of the Metropolitan Gas Referees" for the year 1911 has reached us. These instructions are practically identical with those issued last year, the only change being that the 10 cubic feet of gas burnt for the determination of the total sulphur is allowed to be burnt at a somewhat faster rate—0·62 foot per hour instead of 0·5. In the determination of the calorific value of the gas, the calorie used is now specially defined as "the amount of heat which will raise the temperature of a litre of water one degree centigrade," the temperature at which the water is measured not being stated.

MESSRS. D. APPLETON AND CO. will publish shortly a new work of travel entitled "The Big Game of Africa," by Mr. R. Tjader, who has studied very closely the characteristics of the big game which he has hunted, and paid attention to the scientific side of the subject.

OUR ASTRONOMICAL COLUMN.

METEORS IN FEBRUARY.—Mr. W. F. Denning writes:—"February is not a specially interesting one as regards meteors, but it has presented many brilliant fireballs in past years, and indications of several showers of somewhat important and active character.

"The writer has never made very extensive observations in this month, but from the data he has secured and from the paths of meteors observed by other persons he has long regarded a shower of Aurigids as the most prominent and richest stream of the period. The radiant is about at $75°+42°$, and the time of visibility apparently extends from February 5 to 23, but this is uncertain. The meteors are slow and often bright.

"Observers would do useful work by watching the sky on clear February nights, when moonlight does not materially interfere. They might secure useful evidence as to the Aurigid shower, and would probably notice a few of the fireballs which commonly appear at this time of the year. The most remarkable fireball of modern times appeared on February 22, 1909.

"This year the moon will not interfere in the evening of February 22, and the paths of such meteors as are seen should be carefully registered and other details noted."

NOVA LACERTÆ.—Observations of Nova Lacertæ, made at Bergedorf on January 2, are reported by Dr. Graff in No. 4465 of the *Astronomische Nachrichten*. Two sets of comparisons with neighbouring B.D. stars gave, for the magnitude of the nova, 6·8, and its rose colour is compared with that of Nova Persei in May, 1901, being about 5·5° on Schmidt's scale of colour. Visual spectrum observations gave C and F, probably, and brightenings in the yellow and violet; strong absorptions in the orange and on the other side of F were also noted.

A NEW VARIABLE OR NOVA (134.1910 PISCIUM).—What may prove to be another nova is also reported in No. 4465 of the *Astronomische Nachrichten* by Herr E. Ernst. The discovery was made, whilst comparing some minor-planet photographs of the region near 42 Piscium, on a plate exposed on September 13, 1907, and the image appears to be that of a tenth-magnitude star, in the position α=0h. 27·3m., $\delta=+9° 30'$ (1855·0).

Eighteen other plates, taken during the period October, 1894, to October, 1910, fail to show any image in this position, but one taken on the same evening shows the image to be undoubtedly stellar.

MASS-RATIOS OF THE COMPONENTS OF KRÜGER 60 AND CASTOR.—In No. 5, vol. xxxii., of the *Astrophysical Journal*, Dr. H. N. Russell discusses the mass-ratios in the multiple systems Krüger 60 and Castor.

In the case of the former system, Prof. Barnard has pointed out that the motion of the principal component A is distinctly curved with respect to the distant optical companion C, thus indicating that the faint component B has a mass comparable with that of A; from Prof. Barnard's measures Dr. Russell has calculated the relative masses. He finds that the mass of B is slightly greater than that of A, although the magnitude of A is 9·7, whilst that of B is 11·0; the ratio of the masses is $1·14 \pm 0·14$.

In the case of Castor, Dr. Russell finds that in all probability the "dark" companions in each of the two spectroscopic binaries are much less massive than their primaries, the ratio being greater than for any other system yet investigated. The mass of the whole system is $6·5 \pm 1·0$ that of the sun, whilst, if it is the same in each pair, the mass-ratio (primary/secondary) is about 6·5 in each case; the parallax of Castor is concluded to be approximately $0·08'' \pm 0·03''$.

DOUBLE STARS.—Lick Observatory Bulletin No. 188 contains a list of 100 new double stars discovered and measured by Dr. R. G. Aitken with the 36-inch refractor. This is the seventeenth list published by the same observer, and includes Nos. 2201 to 2300; the sixteenth list appears in No. 184 of the Bulletins.

Dr. Aitken makes some interesting remarks concerning the colours of the components in some 5000 close double-star systems he has examined with the large telescope. Generally, he finds that cases of striking contrast are comparatively rare, and he suggests that this may be due to the fact that the apparent brightness of even faint stars in the field of 36-inch telescopes is considerable, consequently the subjective phenomena recently discussed by Dr. Louis Bell are not so effective as in smaller instruments. Even in the case of A 2250, where the colour of the primary is a striking orange-red, the faint companion can only be described as a dull greyish-white, not blue. In most cases both components appear to be white, although the fainter one is perhaps more bluish than the primary.

No. 4464 of the *Astronomische Nachrichten* contains a long list of measures, made by Prof. Burnham with the 40-inch refractor at the Yerkes Observatory, of stars selected from the General Catalogue for remeasurement because some uncertainty or suspicion of change existed. Appended to the measures are many interesting notes concerning proper motions, existence of planetary and other faint nebulæ in the same region, or apparent discrepancies.

THE UNITED STATES NAVAL OBSERVATORY.—The report of the superintendent of the Washington Observatory for the year ending June 30, 1910, contains, in addition to the usual articles, several notes of special interest.

The observatory has decided to do what it can in the observation of fundamental stars in connection with the International Chart, but for the present cannot undertake more than the observation of the historic fundamental stars. A number of instruments no longer in actual use have been collected into one of the domes as a museum.

Observations of Halley's comet were made from November, 1909, to June, 1910, but during the time the comet was nearest the earth visitors to the observatory were so numerous that the 26-inch and 12-inch equatorials had to be given up to their use; three 5-inch equatorials were also mounted at the Capitol, and two assistants deputed to attend them.

STAR COLOURS.—In No. 4, vol. xxxii., of the *Astrophysical Journal* Mr. Innes has a note on Mr. Bell's paper regarding the physiological factor in the determination of the colours of stars in multiple systems.

Mr. Innes points out that modern observers do not record the fantastic colours recorded by earlier observers, but suggests that they should record colours on the modest "Chandler" scale. He also cites a celestial example, confirmatory of Mr. Bell's laboratory results, where the near approach of Mars—then 4 or 5 on Chandler's scale—gave the yellow binary γ Virginis a decidedly bluish appearance. Mr. Innes also gives examples, however, showing that in some cases the subjective effect apparently does not operate, whilst in others an objective difference almost certainly exists.

THE IMPERIAL DEPARTMENT OF AGRICULTURE IN THE WEST INDIES.[1]

IN recent years the productions of tropical countries have formed an appreciable proportion of the raw material for the manufacturing industries on which the prosperity of this country depends. It is admitted that the British are in possession of some of the richest portions of the tropics, and therefore their development is a matter of great imperial interest. Our responsibilities can hardly be realised; but if our commercial supremacy depends upon the control of the tropics, we cannot relieve ourselves of responsibility either in the interest of our possessions or in our own interests.

It is proposed here to confine attention more particularly to the West Indian colonies, consisting of a group of islands generally known as the British West Indies, Bahamas, and Bermuda, together with the two considerable colonies on the mainland, viz. British Honduras and British Guiana. By their situation in the western tropics and their entire dependence on agriculture, these possessions form a natural group having a common interest in the development of the products of the soil. The West Indies, in the larger sense suggested above, cover an area of 109,836 square miles, or a little less than the British Isles. The population is estimated at 2,300,000. The value of the total trade is about 22,000,000*l*. Of their imports of manufactured and other goods, they take 40 per cent. from the United Kingdom. An increase in the total trade from 15,647,816*l*. in 1903 to 21,429,301*l*. in 1909 is encouraging. It is anticipated that the twentieth century will witness the "regeneration of the West Indies" and a return to some of their former prosperity. Already this is becoming true. Lord Crewe, the late Secretary of State for the Colonies, was in a position to announce in February last "that no West Indian colony was now in want of grants-in-aid." Further, all the colonies have comparatively large sums in reserve to meet any ordinary emergency that may arise.

Briefly stated, the circumstances that have combined to bring about the new prosperity in the West Indies are as follows:—(1) the revival of confidence in the sugar industry as the result of the abolition of bounties, and improved trade relations with Canada; (2) the increase in the production of cacao in Trinidad, Grenada, and Jamaica; (3) the development of the American fruit trade in Jamaica; (4) the introduction of the Sea Island cotton into St. Vincent, Barbados, and the Leeward Islands; (5) the extension of the cultivation of limes in Dominica and rice in British Guiana.

The Imperial Department of Agriculture in the West Indies was created on the recommendation of a Royal Commission consisting of Sir Henry Norman (chairman), Sir Edward Grey, and Sir David Barbour. In 1897, when the commission visited the West Indies, many of the colonies were in a depressed condition and a source of anxiety to the Imperial Government and to those directly interested in them. The commission was charged, in the first place, to inquire into the condition and prospects of the sugar-growing colonies and "suggest such measures

[1] Abstract of a paper read before the Royal Colonial Institute on January 10, by Sir Daniel Morris, K.C.M.G., late Imperial Commissioner of Agriculture.

as would appear best calculated to restore and maintain the prosperity of those colonies and their inhabitants." A further subject of inquiry was: "Whether, in the event of the production of sugar being discontinued or considerably diminished, what other industries could replace it, and be carried on profitably and supply employment for the labouring population."

The commissioners recorded as their opinion that the depression in the sugar industry was due "to the competition of other sugar-producing countries, and in special degree to the competition of beet-sugar produced under a system of bounties." They submitted that "the best immediate remedy . . . would be the abandonment of the bounty system." In the meanwhile they recommended certain special remedies, such as an improved steam communication with outside markets and between the different islands, and the organisation of a scientific department to assist the sugar industry and encourage, where conditions were favourable, minor agricultural industries, together with a general improvement in the system of cultivation of the principal crops.

Most of the recommendations were sooner or later adopted by the Imperial Government, including the creation of an Imperial Department of Agriculture. For the latter, on the motion of Mr. Chamberlain, funds were voted by Parliament on August 2, 1898. The average amount that has been expended up to 1908 has been at the rate of 17,400*l.* per annum. Of this amount, some 5000*l.* represented the cost of the head office; the remainder was applied in grants-in-aid of botanical and experiment stations, agricultural schools, and other educational services in the individual colonies.

The duties entrusted to the department were of a varied and far-reaching character. Among them, the general improvement of the sugar industry and the encouragement of a system of subsidiary industries in localities where sugar could not be grown, or where the conditions were more favourable for the production of cacao, coffee, bananas, oranges, limes, cotton, rubber, cocoanuts, sisal-hemp, rice, nutmegs, pineapples, and other crops. In addition, it was proposed that it should devote attention to the improvement of the breed and condition of cattle, horses, and small stock, and to the extension of bee-keeping. Efforts were also made to bring the mass of the people into sympathy with agriculture and trained to regard the successful treatment of crops as the basis upon which to build, not only their own welfare, but the general prosperity of the colonies. With this view, a prominent position was given to teaching the principles of elementary science and agriculture, both in the primary and secondary schools. Associated with this policy was the increased attention devoted to object-lessons, the encouragement of growing specimen plants in pots and boxes, and the establishment of school gardens. Arbor days for the public planting of ornamental and other trees were also organised and assisted by the department.

The sugar investigations were mainly directed to raising improved varieties of canes capable of withstanding diseases that had rendered the continued cultivation of the Bourbon cane impossible and obtain a larger yield of sugar per acre. Valuable experiments have also been carried on over considerable areas in testing the relative value of pen and artificial manures, and in ascertaining, by a continuous series of trials under skilled supervision, in what quantities and at what stages of growth of the canes such manures could be applied to the best advantage. In addition, investigations have been carried on in the chemical selection of the sugar-cane, in the treatment of cane tops with germicides, and as to the effect of planting at different distances and of improved tillage operations.

A further improvement in the sugar industry has been the establishment of central factories at Antigua, Jamaica, and also at St. Kitts. In the case of the factory at Antigua, it was recently stated "that out of 6000 tons of crystals shipped from the factory, 2500 tons represented the gain due to improved methods of crushing the canes and manufacturing the sugar," that is, the production of sugar from a certain quantity of canes was increased by the factory, as compared with the system hitherto in use, by 40 per cent.

The annual production of sugar in the West Indies is about 240,000 tons, of the value of 3,000,000*l.* In recent years an increasing amount of sugar and molasses has been shipped at preferential rates to the Dominion of Canada. In 1897 Canada took only 11,000 tons of sugar; in 1909 it took 133,000 tons, or about 60 per cent. of the total production of the West Indies.

The result of the policy pursued during the last twelve years is shown in the fact that, while the total exports of produce and manufactures of the West Indian colonies have increased from 5,625,000*l.* to 7,195,360*l.*, the exports of the products of the sugar-cane (sugar, rum, and molasses) have declined from 3,243,000*l.* to 3,037,660*l.* On the other hand, the exports of other commodities, such as cacao, fruit, cotton, logwood extract, tobacco and cigars, rice, coconuts, and rubber, have increased from 1,382,000*l.* to 4,157,700*l.* The recent Royal Commission entirely concurs with the commission of 1897 as to the danger of dependence on a single industry, and they strongly support a continuance of the efforts that have been made with such signal success to develop other industries suitable to the soil and climate.

Several striking instances of the value of scientific investigation for practical purposes have been placed on record both as regards sugar, cacao, cotton, and other industries. The cultivation of Sea Island cotton was introduced in 1903. Since that time, 15,000,000 lb. of cotton lint have been exported, of the value of 800,000*l.* It is admitted that if fine Sea Island cotton had not been obtained from the West Indies, several cotton mills in Lancashire would have been compelled to work short time. The total number of valuable economic plants distributed from the botanic and experiment stations have reached 1,375,151, sufficient to establish about 10,000 acres in permanent crops.

Agricultural education has been extended during the last ten years, with the result that the West Indies are now fully provided with the means for extending agricultural knowledge amongst all classes of the community. Agricultural training schools and farm schools have been provided for boys of the agricultural classes, and the teaching of scientific agriculture has been making steady progress in the secondary schools and colleges. The department has also served a useful purpose as a leading school of tropical agriculture. It is acknowledged that there is no other organisation in any part of the tropics where such diversified work is carried on over so large an area and under such varying conditions of soil and climate. Hence it is possible to afford a sound scientific and practical training to students in the cultivation of crops suited to nearly all tropical conditions. A gratifying proof of the value of the work of the Imperial Department of Agriculture has been the formation of similar departments with well-equipped laboratories and experiment stations in other parts of the tropics; also in supplying trained officers to take charge of these departments.

The valuable services rendered to our tropical colonies by the Royal Gardens at Kew for more than half a century are deserving of special mention. The successful introduction of cinchona into India and Ceylon, and more recently of the rubber trees, which have made it possible to establish the important rubber industries now existing in India, Ceylon, and the Federated Malay States, are not the least of the achievements of Kew.

In a memorandum by Lord Islington, attached to the report of the Canada and West Indian Royal Commission, the following reference is made to the work of the Imperial Department of Agriculture:—

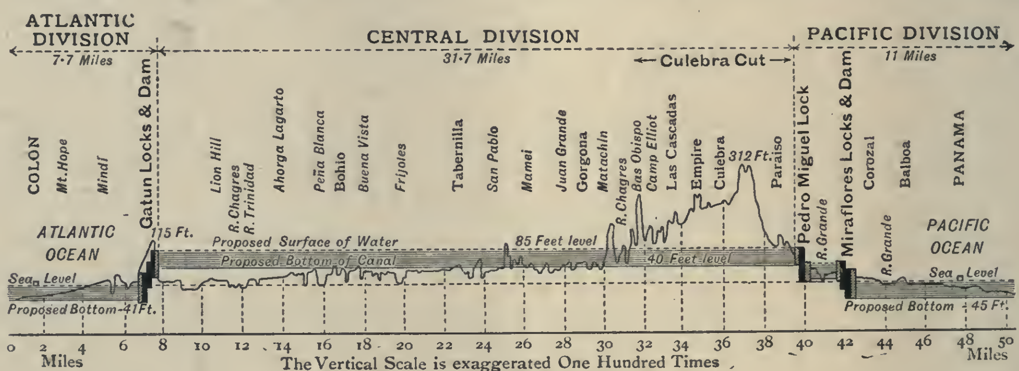
"I was deeply impressed by the value of the work done by the Imperial Department of Agriculture and by the greatness of the possibilities which still lay before it; the revival of the cotton industry, and consequent restoration of comparative prosperity to some of the small islands; experiments with the sugar-cane; the discovery and destruction of insect pests—these were in themselves great achievements. In my opinion, however, an even more valuable work has been done in diminishing the prejudices of agriculturists and inducing them to try new methods and in inculcating the value of science and cooperation. . . . The most successful fruit of the Report of the Commission of 1897 has been the work of the Imperial Department of Agriculture, which has beyond doubt saved the Home Government from appeals which could not wholly

be rejected, and would have cost more than the total outlay on the Department."

In response to the strong recommendations of the Royal Commission, the Imperial Government has recently agreed in principle to the continued maintenance of the central office of the department for a further period of ten years from April 1. This will enable the department under Dr. Watts (the present Commissioner) to continue to coordinate the work of scientific agriculture in the West Indies, to carry on research, and afford still further assistance in developing the resources of the colonies.

THE PANAMA CANAL IN 1910.[1]

THE canal now being constructed by the American Government in continuation of the work commenced by de Lesseps is 50½ miles long from deep water in the Caribbean to deep water in the Pacific. Of this distance 34 miles is high-level with 8 miles sea-level at each end, as shown on the accompanying profile. The water for lockage is supplied by blocking the lower valley of the Chagres River at Gatun with an earthen dam 7000 feet long, 115 feet high, and about 2000 feet broad. This consists of two heaps of broken rock enclosing the hydraulic fill, *i.e.* silt pumped in wet and allowed to drain. This packs tightly under the pressure of the atmosphere, and secures the impermeability of the dam. The heavy rock fills secure its stability against the lateral pressure of the 85 feet of water which will be behind the dam. The height now attained by the dam is 70 feet. The underlying ground is somewhat soft, but it has not been squeezed up owing to the way the load has been spread. The sides of the dam, in fact, hold down the ground so that the weight of the central portion cannot squeeze it up.



Profile of Panama Canal.

The elaborate investigations of the engineers on the spot have shown that the foundations are impervious, the earlier official reports to the contrary having been based upon a misinterpretation of the borings. The area of the lake which will be maintained between this dam and that at Pedro Miguel will be 164 square miles, or twice the size of the Lago Maggiore.

The dimensions of the locks are: length, 1000 feet; breadth, 110 feet. The minimum depths in canal and locks will be 41 feet. The minimum bottom width in the 8 miles of the Culebra cut, 300 feet. The rest of the canal will have a bottom width of from 500 to 1000 feet. The profile shows the greatest original elevation of the ground to be 312 feet, but this is on the central line. On the eastern side at the same place the escarpment began at 534 feet. The bottom will be at 40 feet above mean sea-level, so that the cutting here will be nearly 500 feet deep. The depth of water in this portion of the canal will be 45 feet, the surface being therefore 85 feet above mean sea-level.

The principal difficulty in construction is caused by landslides, brought about by the action of rain, of which 90 inches falls in the year at Culebra. The basalt rock is overlaid with disintegrated rock and with clay to an average thickness of 15 to 20 feet, and the rock itself in places has open joints or seams, either vertical or sloping towards the cut. Frequently the first sign of a landslide is the bulging up or humping of the basalt rock at the bottom of the cut, which sometimes rises 20 feet. Simultaneously a crack appears on the soil above, which is followed by foundering of the soil and clay, and very often of the rock. Obviously, so long as humping of the bottom occurs, it would be futile to let in water, as the canal might be at any moment so reduced in depth as to be unnavigable. It is proposed to deal with the difficulty by flattening the slopes until gravitational equilibrium is achieved, on the principle already referred to in the case of the Gatun dam.

The author points out the existence of a gravitative wave in landslides, and recommends the application of the principles and terminology of surface waves to their study.

In spite of the difficulty of the landslides, the opening of the canal may be expected on the promised date, viz. January 1, 1915.

[1] Abstract of a paper read before the Royal Society of Arts on December 9 by Dr. Vaughan Cornish.

APPLIED GEOLOGY IN THE UNITED STATES.[1]

THE eight bulletins referred to below cover a wide range of applied geology, and contain many valuable additions to academic geology. Thus the memoir by Messrs. Hillebrand and Schaller is a most important contribution to knowledge of the minerals containing mercury. It gives the result of a thorough research on kleinite, montroydite, terlinguaite, and eglestonite. The two last are proved to be oxychlorides, and montroydite to be an oxide of mercury, confirming the conclusions of Prof. Moses, the founder of these species. Kleinite was named in 1905 by Prof. Sachs, who described it as an oxychloride of mercury, but the day after his paper was

[1] F. C. Schrader: Mineral Deposits of the Cerbat Range, Black Mountains, and Grand Wash Cliffs, Mohave County, Arizona. U.S. Geol. Survey, Bull. 397. Pp. 226+xvi plates+37 figs. (Washington, 1909.)
E. F. Burchard and C. Butts: Iron Ores, Fuels, and Fluxes of the Birmingham District, Alabama, with chapters on the Origin of the Ores, by Edwin C. Eckel. U.S. Geol. Survey, Bull. 400. Pp. 204++xvii plates, +19 figs. (Washington, 1910.)
W. F. Hillebrand and W. T. Schaller: The Mercury Minerals from Terlingua, Texas. U.S. Geol. Survey, Bull. 405. Pp. 174+vi plates+44 figs. (Washington, 1909.)
W. H. Emmons: A Reconnaissance of some Mining Camps in Elko, Lander, and Eureka Counties, Nevada. U.S. Geol. Survey, Bull. 408. Pp. 130+v plates+22 figs. (Washington, 1910.)
A. G. Maddren: The Innoko Gold-Placer District, Alaska, with Accounts of the Central Kuskokwim Valley and the Ruby Creek and Gold Hill Placers. U.S. Geol. Survey, Bull. 410. Pp. 87+v plates. (Washington, 1910.)
F. L. Hess: A Reconnaissance of the Gypsum Deposits of California, with a Note on Errors in the Chemical Analysis of Gypsum, by George Steiger. U.S. Geol. Survey, Bull. 413. Pp. 37+iv plates+2 figs. (Washington, 1910.)
F. L. Ransome: Notes on some Mining Districts in Humboldt County, Nevada. U.S. Geol. Survey, Bull. 414. Pp. 75+i plate+7 figs. (Washington, 1909.)
The Valuation of Public Coal Lands. G. H. Ashley: The Value of Coal Land. C. A. Fisher: Depth and Minimum Thickness of Beds as Limiting Factors in Valuation. U.S. Geol. Survey, Bull. 424. Pp. 75. (Washington, 1910.)

read, in Berlin Hillebrand announced that the mineral is a mercury-ammonium compound; it is a mixture of mercury ammonium chloride with some sulphate or oxysulphate. Some interesting photographs illustrate the optical heterogeneity of the mineral. Kleinite is hexagonal in symmetry, but basal sections are only singly refracting when heated above 130°; after cooling very slowly, in process of years, again become biaxial.

Three of these bulletins (Nos. 397, 408, and 414) state the results of inspections of western mineral fields where mining was once more active than it is now. Mr. F. C. Schrader describes the ore deposits of Mohave County, in north-western Arizona. The country consists of a plateau of pre-Cambrian gneisses covered in places by Cainozoic volcanic rocks, and flanked by Palæozoic sediments in the valley of the Colorado River. The climate is warm, and with a 5-inch rainfall and high evaporation there is little surface water, and the rocks are oxidised to the depth of usually from 200 to 600 feet. The mines are numerous, but they are all hampered by the difficulties of access and high costs, and so none have been worked very deeply. The outcrops were removed thirty years ago. The mines belong to two main types, one represented in the Cerbat Range, occurring in the pre-Cambrian rocks, and the other, as in the Black Mountain, found in the Cainozoic volcanic formation. The ores in the latter are found only in association with chloritic andesites. The field shows many points of interest, and the results will be watched with interest as the mines go deeper. The plans suggest that some of the ore shoots have been formed from ascending solutions. The evidence available is insufficient to throw much light on general problems, but Mr. Schrader's report will be indispensable in the future development of the field.

Mr. W. H. Emmons's reconnaissance on some mining camps in Nevada also deals with small scattered mines of which most of the direct evidence has been lost. Some of them were worked fifty years ago, and mining was most active during the silver boom of the 'eighties. The mines, unlike those in Mohave County, yield a large variety of minerals. The area consists of Palæozoic sediments, ranging from the Cambrian to the Carboniferous, which have been invaded by Cretaceous granodiorites, and covered in places by Miocene rhyolites, andesites, and basalts. One series of mines consists of replacements in what the author calls the "marbleised limestone" around the Cretaceous granodiorites, and a second series occurs with the Cainozoic eruptives, but only in association with the andesites; the basalts are always barren, and the rhyolites are only productive when near andesite. The chief metals in both series of mines are gold and silver. The gold is relatively more abundant in the older lodes, where it is associated with copper and lead. The mines only occur where the rocks have been leached by hot water, and thus prospectors recognise promising positions by the colour of the weathered rocks.

Mr. F. L. Ransome has examined Humboldt County, Nevada, of which the map prepared by the historic Survey of the Fortieth Parallel is still the best. Mining began in the district about 1860 on ores of antimonial silver with stibnite and cinnabar. In Copperwood Canyon small veins of nickel and cobalt ores occur in an altered andesite beside a diorite, probably of Cretaceous age. Mr. Ransome shows his characteristic insight in the classification of the ore bodies and in such illuminating diagrammatic sections as that of the Sheba mine (p. 42).

The gypsum deposits of California are described in a short memoir by Mr. F. L. Hess. The gypsum is mined for use as plaster and a fertiliser. Some of it occurs in "gypsite," a material containing grains of gypsum too small to be readily discernible to the eye. It is there an efflorescent product, due to the evaporation of water, which has percolated through underlying gypsiferous beds. Some massive deposits formed by the evaporation of shallow lakes and by precipitation in shallow sea water are also of local commercial value. The veins of gypsum, including both selenite and satinspar, have no intrinsic value, but are worked as the cheapest method of holding mineral leases on land which may yield oil. Sufficient work is done on the gypsum to maintain the lease without the expense of boring for oil, and thus dodging the law by using one mineral to maintain an unfair claim to another.

The valuation of coal lands is a problem which has long taxed the ingenuity of experts on mining law. In Bulletin 424 Mr. Fisher contributes to the discussion a summary of the depth and minimum thickness of coal seams worked in various countries. The deepest coal mining recorded is from 3937 feet, in Belgium; the deepest in Britain is at 3483 feet, in Rams Mine, Pendelton; and depths of more than 3000 feet have been reached in France and Germany. Forty years ago a British Coal Commission recognised that mining would reach a depth of 4000 feet, but such is the wealth in fuel of the United States that coal below 3000 feet is still disregarded in valuation. The United States, moreover, has not yet been driven to work such thin coals as are wrought in England and Belgium. The thinnest English seams worked at present independently are a cannel coal of 8 inches and ordinary coal 10 inches thick. Seams 12 inches thick are worked in Belgium and Scotland, where beds of less than 2 feet thick are worked extensively.

The red iron ores in the Silurian rocks of Alabama, described in Bulletin 400, are second in importance in the United States only to those of the Lake Superior district. They are low-grade ores, but being near fluxes and fuel are cheaply worked. The Clinton ores have generally been regarded as a residual deposit due to concentration of iron oxide by solution of a ferruginous limestone. This view has been based upon the belief, due to Porter and I. C. Russell, that the ironstones pass below into normal limestone. This view has been accepted by many later economic geologists, but is rejected by Eckel, as the ore is already being mined far from the outcrop, and has been found in New York in bores ten to fifteen miles from the outcrop, and nearly 1000 feet below the surface. The ore is often oolitic and contains many marine fossils which have been altered into iron oxide, but that this change happened during the deposition of the rock is indicated by several facts. Thus many of the oolitic grains contain a nucleus of quartz grains surrounded by concentric layers of iron ore, which is covered by carbonate of lime. A fuller account and figures of the microscopic structure of the ores would have been useful. As the oolitic grains have been cemented by iron oxide, some replacement appears to have taken place after the formation of the bed. Mr. Eckel, however, produces weighty evidence in support of his view that the ore is mainly of contemporary origin, though recent work shows that other American geologists reject this explanation, and regard the estimates based on it as exaggerated.

The brown ores of Alabama are admitted by Mr. Eckel to be epigenetic; they are interbedded with Cambro-Ordovician, Cretaceous, and Cainozoic rocks, but are all of Cainozoic formation.

Mr. Maddren's report on some Yukon placer deposits shows that the gold has been derived from lodes formed by the intrusions of acid rocks in Mesozoic or Lower Cainozoic times. The gold is usually coarse, but its concentration has been slow, because the cold acts as a cementing agent, and the erosion of the frozen ground is very slow. The report gives some interesting information as to the relative extent of Glacial and post-Glacial denudation in some Alaskan valleys.

J. W. G.

ON THE SENSIBILITY OF THE EYE TO VARIATIONS OF WAVE-LENGTH IN THE YELLOW REGION OF THE SPECTRUM.[1]

DR. EDRIDGE-GREEN[2] has introduced a method of classifying colour-vision by determining the number of separate parts or divisions in the spectrum within each of which the observer can perceive no colour difference. Movable screens are provided in the focal plane of the spectroscopic telescope, by which the part admitted to the eye is limited and the limits measured in terms of wave-length. Beginning at the extreme visible red, more and more of the spectrum is admitted until a change of colour (not merely of brightness) is just perceptible. This gives the first division. The second division starts from the place just determined, and is limited in the direction of

[1] Abstract of a paper read before the Royal Society on December 8, 1910, by Lord Rayleigh, O.M., F.R.S.

[2] Roy. Soc. Proc., B, 1910, vol. lxxxii., p. 458, and earlier writings.

shorter wave-length by the same condition. In this way the whole spectrum is divided into a number of contiguous divisions, or patches, which Dr. Green terms monochromatic.

"Tested with this instrument a normal individual will, as a rule, name six distinct colours (viz. red, orange, yellow, green, blue, violet), and will mark out by means of the shutters about 18 monochromatic patches. Occasionally we come across individuals with a greater power of differentiating hues, to whom, as to Newton, there is a distinct colour between the blue and violet, which Newton called indigo. Such individuals will mark out a greater number of monochromatic patches, from 22 up to 29. The limited number of monochromatic patches which can be marked out in this way is at first surprising when we consider how insensibly one part of the spectrum seems to shade into the next when the whole of the spectrum is looked at. The number and position of the patches present, however, great uniformity from one case to another."

Being curious to know into what class my own vision would fall on this system, I was glad to be tested by Dr. Green last July. The number of patches proved to be 17, a little short of what Dr. Green lays down in the passage above quoted as normal. The limits of the actual patches were as follows:—

780—635½—624—612—603—595—586—576—560—541—521—509—500—489½—477—462—443—426.

Thus in the region of the D lines a patch including wave-lengths between 595 and 586 did not manifest a difference of colour. The interval between the D lines on the above scale being 0·60, it appears that my "monochromatic patch" was 15 times this interval.

While it is undoubtedly true that in this way of working no colour-difference was perceptible as the eye travelled backwards and forwards over the patch, my experience with colour discs and other colour-mixing arrangements made me feel certain that under more favourable conditions I could discriminate much smaller differences of wave-length. Special experiments have since proved that I can, in fact, discriminate by colour between points in the spectrum so close together as the two D lines.

In order to compare two colours with advantage it is necessary that each should extend with uniformity over a considerable angular area, and that the two areas should be in close juxtaposition. The requirements of the case are sufficiently met by a colour-box (after Maxwell) such as I described nearly thirty years ago.[1] In this form of apparatus a second slit, placed at the focus, allows a narrow width of the spectrum to pass; but instead of regarding the transmitted portion with an eye-piece, the eye is brought close to the slit and focussed upon the prism, which thus appears uniformly lighted with such rays as the second slit allows to pass. The light thus presented is, of course, not absolutely homogeneous; it includes a mixture of neighbouring spectrum rays, the degree of purity augmenting as the slits are narrowed. With the aid of a refracting prism of small angle (set perpendicularly to the dispersing prisms) the field of view is divided into two parts, which correspond to any desired colours according to the situation of the two primary slits. For the present purpose these primary slits lie nearly in one straight line, inasmuch as the two spectrum colours to be compared are close together.

In making the observations on sensitiveness, one primary slit, as well as the eye-slit, remains fixed, the position being chosen so as to provide yellow light from the neighbourhood of D. The second slit can be moved as a whole while retaining its width.

The procedure is quite simple. If the colours seen are strongly contrasted, the movable slit is displaced until the difference is moderate. Marks may then be given: O, denoting that the difference is uncertain; R_1, that it is just distinct in the direction of making the second patch the redder; G_1, that it is just distinct in the opposite direction. Similarly, R_2, G_2, denote differences in the two directions which are more than distinct, and so on. After each observation worth recording, the position of the movable slit is measured.

In this manner, as the result of sets of observations made on several days, it was found that a movement of the second slit through 0·15 mm. was sufficient to carry the variable colour from being distinctly redder than the standard to distinctly greener. We may conclude that the eye is capable of appreciating without fail a difference of situation represented by 0·07 mm.

It remains to interpret the result in terms of wave-lengths. By allowing light to enter at the eye-slit, or rather at a narrower slit superposed upon it, a spectrum is formed at the other end the scale of which has to be determined. It appeared that the distance from D to E was 7 mm. The difference of wave-length between these lines is 62·3. The perceptible difference is 1/100 of this, corresponding nearly enough to the difference between the D lines. I think I am safe in saying that I could distinguish the colours of the two D lines if favourably presented to the eye.

This degree of sensitiveness, though not higher than I had expected, is a little difficult to reconcile with the monochromatic appearance of a portion of the spectrum fifteen times wider. I suppose that the gradual character of the transition is an obstacle to the recognition of differences. The question of angular magnitude may also enter. No doubt a very small apparent magnitude would be unfavourable. It is possible that in Dr. Green's apparatus an eye-piece of higher power, with a corresponding augmentation in the intrinsic brilliancy of the source of light, would allow of an increase in the number of distinguishable patches. The experiment would be worth a trial.

It will be seen that the existence of "monochromatic patches" in the spectrum is far from meaning that the eye is incapable of making chromatic distinctions within their range. I do not infer from this that the results of the method are without significance. Undoubtedly it is possible by means of it to classify colour-vision, and such a classification cannot be without interest, even if we fail as yet to understand exactly what it means.

[1] NATURE, 1881, vol. xxv., pp. 64–66; "Scientific Papers," vol. i., p. 543 See also NATURE, August 18, 1910.

THE PROGRESSIVE DISCLOSURE OF THE ENTIRE ATMOSPHERE OF THE SUN.[1]

LE soleil auquel est consacrée cette conférence est un magnifique sujet d'études. Tous les hommes sentent plus ou moins clairement que les destinées terrestres sont liées étroitement à celles du soleil, et qu'il est nécessaire de reconnaître sa nature intime, son rayonnement total, ses variations, en un mot son action précise et complète sur notre globe. Notre dépendance vis-à-vis du soleil est absolue, et récemment, elle a été résumée d'une manière simple par un homme politique français, maintenant ministre des finances, auquel je demandais un crédit spécial pour l'observatoire de Meudon que je dirige, et pour les recherches solaires. Il refusait d'abord, en alléguant l'acroissement continu des dépenses publiques. Puis, comme j'insistais, il s'écria: "Vous avez raison, le soleil est *notre maître* à tous; il est impossible que nous ne fassions pas quelque chose." C'est ainsi que l'observatoire de Meudon a pu joindre à son budget ordinaire une somme supplémentaire, certes peu élevée, mais qui est arrivée au moment opportun, et nous a beaucoup aidés dans les recherches que je vous présente aujourd'hui.

L'étude moderne du soleil exige en effet des installations coûteuses, des appareils compliqués et un personnel spécial apte aussi bien aux observations physiques qu'aux observations astronomiques. Or le soleil luit pour tout le monde, et mûrit toutes les moissons; et, à priori, il semble naturel que tous les hommes de la planète apportent leur concours aux recherches solaires. Partant de cette idée, j'ai proposé, il y a quelques années, à la Société astronomique de France une taxe spéciale et générale pour le soleil—et d'ailleurs très minime. Si chaque français, ai-je remarqué, donnait par an un sou, un simple sou pour le soleil, la somme totale serait encore élevée; elle permettrait d'assurer l'enregistrement continu du soleil et de ses variations, non encore réalisé, et donc une connaissance plus approfondie de l'astre. Mais les taxes nouvelles sont toujours plus nombreuses, et celle-là, bien que très faible et très légitime,

[1] Discourse delivered at the Royal Institution of Great Britain on Fri June 10, 1910, by Dr. H. Deslandres, Membre de l'Institut.

serait probablement écartée. D'ailleurs, il faut bien le dire, l'homme civilisé actuel, le citadin surtout, s'occupent peu du soleil; ils le regardent moins que l'homme primitif et le sauvage qui n'ont ni montre ni almanach. La réalisation de cette idée est réservée pour la cité future, et pour un état social plus parfait que le nôtre.

Le recours au gouvernement, à la collectivité, est une habitude française. Il vaut mieux comme en Angleterre, faire appel à l'initiative privée, à l'initiative d'hommes éclairés et généreux. C'est ainsi qu'a été fondée la Royal Institution, qui a vu éclore tant de belles découvertes et tant de savants illustres. Ce bel exemple doit être proposé à tous, et on sait qu'il a été largement suivi en Amérique où les plus grands observatoires, et surtout ceux consacrés au soleil, sont dus à de simples particuliers.

En fait, dans les cinquante dernières années, grâce à de grandes découvertes, grâce à l'appui des gouvernements et des Mécènes, l'étude du soleil a pris un développement considérable. Les astronomes ont pu lui donner peu à peu une organisation sérieuse et permanente et même l'étendre à l'atmosphère entière de l'astre, jusqu'alors inaccessible.

La découverte principale sur le soleil est la variation périodique de ses taches noires, variations que subissent aussi les facules brillantes de la surface et l'atmosphère entière très étendue. Le soleil entier a une grande oscillation générale; et, fait plus curieux encore, cette oscillation s'étend à la terre et, tout au moins, à ses éléments magnétiques.

L'extension du phénomène solaire à la terre a une importance capitale; elle implique presque nécessairement une action spéciale, nouvelle, exercée par le soleil sur notre globe: elle est la cause première de la grande faveur actuelle des recherches solaires. Après la découverte de Sabine et Lamont sur l'accord de nos variations magnétiques avec le soleil, la science anglaise a accordé la plus grande attention aux taches du soleil; et *la première* elle a organisé l'enregistrement photographique des taches et des éléments magnétiques sur plusieurs points du globe, et la concentration de tous ces documents dans un même observatoire qui les relève avec précision. Les travaux d'Ellis et de Maunder sur la question sont bien connus et il convient aussi de rappeler ceux de Lockyer et de Shuster, qui ont reconnu récemment dans les variations des taches des périodes plus grandes et plus petites que la période principale de 11 années.

L'action exercée par le soleil sur la terre est attribuée généralement aux taches; mais elle peut avoir son origine dans l'atmosphère solaire qui a les mêmes variations; d'où la nécessité d'étudier et de relever avec soin cette atmosphère. Or, depuis près de 20 ans, je me suis attaché à la reconnaissance de l'atmosphère entière du soleil, et je vous présente aujourd'hui les résultats les plus récents, qui ont mis au jour les couches supérieures de cette atmosphère jusqu'ici inexplorées.

Atmosphère des éclipses—au bord solaire extérieur.

L'atmosphère du soleil s'est montrée à l'homme pour la première fois dans les éclipses totales, au bord solaire extérieur. Elle forme alors l'anneau lumineux qui se détache sur le fond du ciel devenu noir, en entourant le disque lunaire, également noir. Elle comprend deux parties distinctes, à partir de la lune et du bord solaire: la *chromosphère* mince et brillante, de couleur rose, de laquelle se détachent les proéminences également roses, et *la couronne*, plus pâle mais très étendue. Dans ce qui va suivre, il sera question surtout de la chromosphère et des proéminences.

En temps ordinaire l'anneau lumineux des éclipses est caché par l'illumination beaucoup plus vive de notre ciel. L'écran qui le masque est lumineux; pour l'écarter, l'astronome anglais Sir Norman Lockyer, a eu le premier, en 1866, l'idée de recourir au spectre, en admettant, ce qui était probable, que l'atmosphère solaire fût gazeuse. C'était *une idée de génie*, qui depuis a fait son chemin.

L'éclipse de 1868 montre en effet que les proéminences roses sont constituées en grande partie par l'hydrogène incandescent qui émet les radiations déjà reconnues dans le laboratoire sous l'influence de l'étincelle électrique, et en particulier une raie rouge intense appelée H_a. Et, après l'éclipse, Janssen aux Indes, Lockyer en Angleterre, avec le spectroscope et la raie rouge, retrouvent les proéminences et la chromosphère des éclipses. Ce résultat a excité un enthousiasme légitime; car la méthode, à la fois simple et féconde, est employée depuis 40 ans à la reconnaissance journalière de la chromosphère, des positions et des formes des proéminences. Cette étude est même plus captivante que celles des taches; car les proéminences ont les formes les plus variées et les changements les plus rapides. Elles apparaissent à toutes les latitudes, et suivent aussi la période undécennale des taches, la durée du maximum étant, il est vrai, plus longue.

L'étude spectrale du bord solaire, poursuivie en temps ordinaire, ou mieux pendant les éclipses, fait aussi connaître la composition chimique de la chromosphère, et aussi la hauteur minime de chaque vapeur, estimée par la longueur de la raie correspondante dans le spectre.

D'une manière générale, les vapeurs à faible poids atomique et les gaz légers s'élèvent le plus haut; tel est le cas de l'hydrogène et de l'hélium. La raie la plus haute dans ces deux gaz est la raie rouge $H\alpha$ de l'hydrogène, les autres raies de l'hydrogène ayant des hauteurs et des éclats qui diminuent du rouge à l'ultraviolet.

Mais les plus hautes de toutes sont les raies violettes H et K, très brillantes, qui sont émises par les composés du calcium. Comme le poids atomique et la densité de la vapeur de calcium sont relativement élevées, le fait paraît assez étrange; il est expliqué simplement, d'après les idées de Lockyer, par une dissociation du calcium dans le soleil et l'étincelle de nos laboratoires. Les raies H et K, à tous égards exceptionnelles, sont très brillantes au bord solaire, et assurent aisément la photographie des proéminences avec les plaques ordinaires.

D'autre part, les vapeurs lourdes, qui sont de beaucoup les plus nombreuses s'élèvent peu dans l'atmosphère, et ne sont aisément visibles que dans les éclipses. Elles forment la couche basse de la chromosphère, relativement fort brillante, appelée *couche renversante*.

Chromosphère projetée sur le disque, couche moyenne.

Tels sont les résultats principaux de la méthode Lockyer-Janssen. Ils sont assurément remarquables, mais, à certains égards, incomplets. Ils ne s'appliquent qu'à la partie de la chromosphère *extérieure* au bord solaire, et même aux vapeurs légères, et élevées de ce bord. La partie intérieure au bord, ou projetée sur le disque, en projection 50 *fois* plus étendue, lui échappe. Or cette lacune a été comblée de 1892 à 1894 par une méthode *absolument générale*, qui décèle toutes les vapeurs, lourdes ou légères, et leurs couches successives dans la demie-sphère entière tournée vers la terre.

Au bord solaire, les raies des vapeurs se détachent brillantes sur le spectre continu de notre ciel; mais, sur le disque, ces raies sont noires, comme on sait, et le spectre continu qui leur sert de fond est celui du soleil lui-même et est beaucoup plus intense. A priori la difficulté paraît beaucoup plus grande.

Or les raies H et K du calcium présentent une exception à cette règle, et le fait a été annoncé simultanément en février 1892 par Hale et Deslandres. Ces raies noires sont très larges et même les plus larges du spectre solaire; mais, aux points de la surface où *est une facule*, elles sont renversées, autrement dit elles offrent en leur centre une raie brillante qui même est double et se détache sur la large raie noire aussi bien que la raie des proéminences au bord extérieur. (Voir la Fig. 1, qui montre la raie K et ses composantes K_{1v}, K_{2v}, K_3, K_{2R}, K_{1R}.)

Le résultat a été obtenu par Hale avec un spectrohéliographe, appareil nouveau, assez complexe, qui isole une radiation avec une seconde fente, et, par le mouvement de cette fente lumineuse, fournit une image monochromatique de l'astre. De mon côté, j'ai employé le simple spectrographe ordinaire et des sections successives, mais en préconisant l'emploi du spectrohéliographe.

Cependant les deux observateurs étaient en désaccord sur un point capital. Hale plaçait les vapeurs ainsi décelées dans la facule même, sous la surface; je les plaçais au contraire au-dessus dans l'atmosphère même. Or le spectrographe ordinaire, qui réunit tous les éléments de la question, permet de la résoudre; il est, à ce point de vue, supérieur au spectrohéliographe.

La raie double K_2 est brillante non seulement sur les facules, mais sur tous les autres points du disque où elle est, il est vrai, plus faible et plus difficile à distinguer. De plus, au bord, la raie brillante double K_2, au bord intérieur, est toujours nette en ce point, et est prolongée à l'extérieur par une raie brillante double identique. (Voir la Fig. 2 ci-contre, figure schématique, qui montre bien l'aspect de la raie double K_2, au bord du soleil et aussi sur une tache.)

Comme la raie K_2 extérieure au bord représente par définition la chromosphère, la conclusion est la suivante: *L'image de la raie K_2 avec le spectrohéliographe représente la chromosphère entière de l'astre projetée sur le disque.*

D'ailleurs les images du calcium faites à Paris en 1894 et qui sont les premières images complètes, montrent des

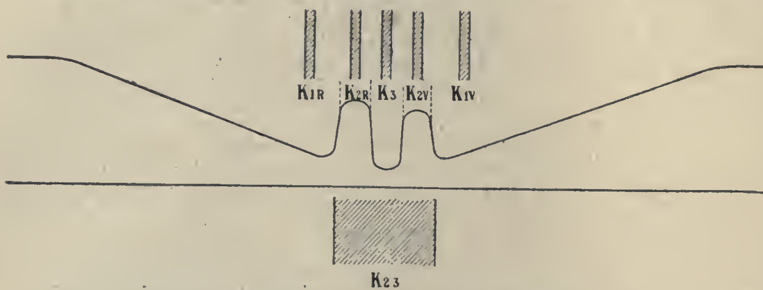


FIG. 1.—Courbe des intensités du spectre solaire à l'emplacement de la large raie noire K. On a représenté par des traits avec hachures les positions des fentes des spectrohéliographes.

plages faculaires brillantes plus larges que celles de la surface, et aussi les parties brillantes plus petites appelées maintenant *flocculi*, qui sont présentes aussi bien aux pôles qu'à la lignateur—j'ai vérifié la présence des flocculi aux pôles dans les années de minimum et pendant la période undécennale tout entière.

La raie brillante K_2 reste double au bord extérieur jusqu'à 4′ ou 5′ d'arc, et, comme la chromosphère au bord est haute de 10″, on peut dire que cette image représente la chromosphère moyenne.

En résumé, si le premier spectrohéliographe ayant donné des résultats a été réalisé en Amérique, c'est en France qu'on a reconnu pour la première fois la chromosphère entière du soleil.

Chromosphère basse.

Mais on peut aller plus loin. En 1893, j'ai annoncé que l'isolement d'une raie noire ordinaire avec le spectrohéliographe donnerait l'image même de la vapeur correspondante; et, en 1894, j'ai isolé avec le petit spectrohéliographe de faible dispersion, organisé à Paris, les bords dégradés de la raie K, appelées K_{1R}, et K_{1V}, et les raies noires voisines les plus larges de l'aluminium, du fer et du carbone. L'image obtenue diffère de celle de K_2; les taches masquées par fois avec K_2 ont toujours leur ombre et pénombre bien nettes, et les plages faculaires sont brillantes au centre comme au bord, mais moins larges que dans l'image K_2. En fait, cette image nouvelle est intermédiaire entre l'image de la surface et celle de la couche moyenne chromosphérique K_2. Elle représente l'image de la couche renversante entière qui serait obtenue ainsi pour la première fois.

J'ai ajouté qu'une dispersion plus forte permettrait d'isoler les raies plus fines qui sont les plus nombreuses, et, en particulier, la petite raie noire centrale K_3, entre les deux composantes K_2. Cette raie K_3 correspond à la couche supérieure de la chromosphère. La méthode s'annonce ainsi comme absolument générale; elle fournit l'image de toutes les vapeurs solaires, et *aussi* l'image de leurs couches successives superposées, au moins lorsque la raie est divisible en parties distinctes, ainsi que la large raie K.

Or le nombre des raies solaires s'élève à 20,000; et, d'après Jewell, toutes les raies solaires offrent plus ou moins la constitution spéciale de cette raie typique du calcium. Le champ nouveau offert à l'investigation s'annonce comme extrêmement étendu.

Recherches ultérieures. Grand Spectrohéliographe d'un type nouveau.

Le programme de recherches, indiqué en 1894, est donc extrêmement vaste. Il a été appliqué en partie dans les années suivantes, et les progrès ont été réels si non très rapides.

En 1903, Hale et Ellermann, à l'observatoire Yerkes, reprennent l'étude des raies noires, avec un spectrohéliographe plus dispersif, et la poursuivent à partir de 1906 au Mont Wilson avec des appareils encore plus puissants. Ils ont obtenu de magnifiques images et toute une série de faits nouveaux. Avec les raies de la couche renversante, les résultats sont à peu près les mêmes que ceux de 1894; mais les raies de l'hydrogène, et tout récemment la raie H_α ont montré des phénomènes nouveaux, très curieux, dont il sera question avec détails un peu plus loin.

Cependant la dispersion employée par eux est seulement moyenne; s'ils ont isolé un nombre de raies bien plus grand qu'en 1894, ils n'ont pas isolé les raies fines; et même dans chaque cas, ils ont isolé la raie entière, ils n'ont pas séparé les parties distinctes de la raie et donc les couches successives de la vapeur. Leur image est un mélange de plusieurs images distinctes et de plusieurs couches.

Je me suis proposé de combler cette lacune, et de poursuivre jusqu'au bout le programme de 1894, en isolant nettement les couches supérieures non encore décelées. Devenu directeur de l'observatoire de Meudon en 1907, j'ai pu diriger de ce côté les ressources de l'observatoire, et, d'autre part la crédit extraordinaire signalé plus haut, nous

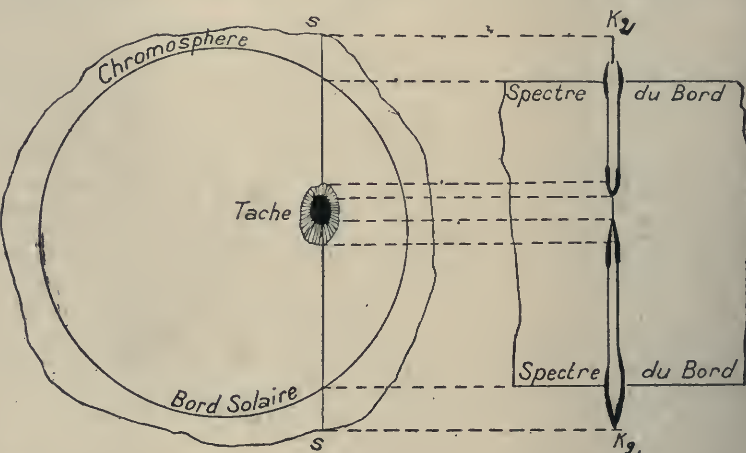


FIG. 2.—(schématique).—*ss*, section faite par la fente du spectroscope dans le soleil dont la chromosphère et la tache sont très agrandies; K_2, raie brillante, attribuée aux vapeurs du calcium, qui apparaît au milieu de la large raie noire K du spectre normal; elle est simple et fine au-dessus des taches et à la partie supérieure de la chromosphère, et double sur les autres points, étant alors divisée en deux par la raie noire centrale K_2.

a été fort utile. Bref il a été possible de construire un grand spectrohéliographe, aussi dispersif que le grand spectrographe de Rowland et un grand bâtiment spécial capable de le contenir.

Le bâtiment comprend une grande pièce de 22 m. sur 6 m.; son toit est en pierre et terre, ce qui assure la constance de la température à l'intérieur. Il reçoit la lumière solaire d'un cœlostat placé au sud, constitué avec de vieux appareils du passage de Vénus, et d'un objectif ancien de 0·25 m. d'ouverture et 4 m. de distance focale. Ces pièces, qui sont médiocres, ont été utilisées par raison d'économie. Le spectrohéliographe, d'autre part, est d'un type nouveau, et offre plusieurs particularités intéressantes. Il est assez compliqué, au moins sur le dessin, car il comprend en

réalité quatre spectrohéliographes différents réunis autour d'un même collimateur. Le premier est à trois prismes et à deux fentes, avec une chambre de 3 m., et une image du soleil de 85 mm. : le second est à réseau et à deux fentes avec une chambre de même longueur. Le troisième est une disposition différente des deux précédents. Enfin le quatrième, le plus puissant, est à trois fentes, à prismes ou à réseau. Il comprend un premier spectrographe avec chambre de 7 m., ainsi que dans l'appareil classique de Rowland, ce qui permet d'isoler des raies très fines. Mais l'image solaire exigerait une pose trop longue; on la reprend avec une second spectrographe qui le diminue au dégré voulu, et élimine la lumière diffuse intérieure. Le soleil final a un diamètre qui peut être quelconque, et, grâce à certaines dispositions spéciales, *il est entier*, ce qui n'est pas réalisé dans les autres spectrohéliographes de grande dispersion. Les diamètres habituels sont 6 cm. et 4 cm.

L'appareil, avec ses deux spectrographes, a une longueur totale de 14 m., et, dans ces conditions, reste immobile. Il est même le premier spectrohéliographe dont toutes les parties sont fixes, la plaque étant mise à part. Les pièces mobiles sont la plaque photographique et l'objectif astronomique, qui sont mis en mouvement à la vitesse voulue par des moteurs électriques synchrones et des transformateurs de vitesse spéciaux.

La concordance des mouvements est assurée par des moyens électriques, indépendants de la distance, et le dispositif est présenté comme une solution générale du spectrohéliographe. Chacun des quatre spectrohéliographes a ses avantages particuliers, et le passage de l'un à l'autre se fait en quelques minutes. L'observateur a ainsi à sa disposition des moyens d'investigation variés. D'une manière générale, les spectrohéliographes à deux fentes de 3 m. donnent une image plus grande et plus riche en détails. Le grand appareil de 14 m. à trois fentes, donne, avec une pose plus longue, une image plus petite, mais beaucoup plus pure; il permet d'isoler des raies plus fines.

Les recherches avec cet appareil ont été poursuivies avec un jeune astronome de l'observatoire, M. d'Azambuja, dont le nom est associé au mien.

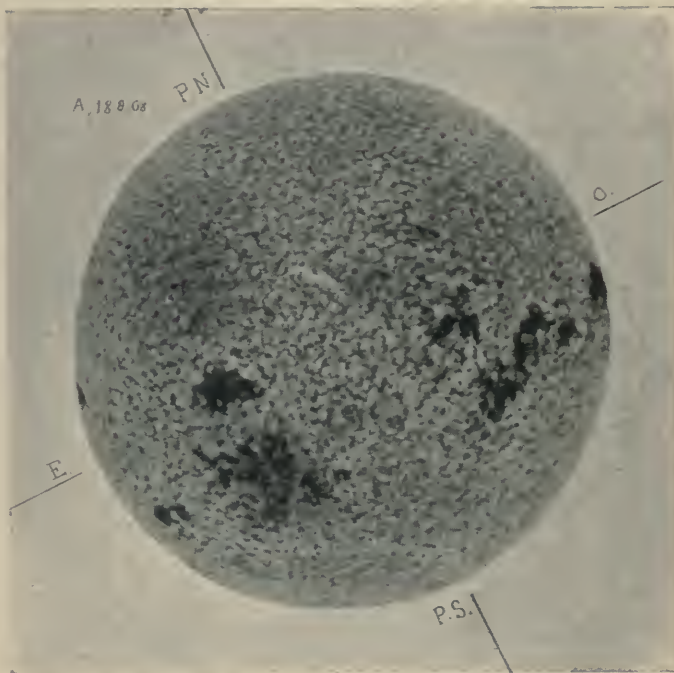
Révélation de la couche supérieure K_3 du Calcium.

En 1908 nous avons pu isoler la petite raie noire centrale K_3 du calcium, et donc la couche supérieure de la vapeur. La Fig. 1 qui montre la raie K et ses composantes permet de bien juger le progrès réalisé.

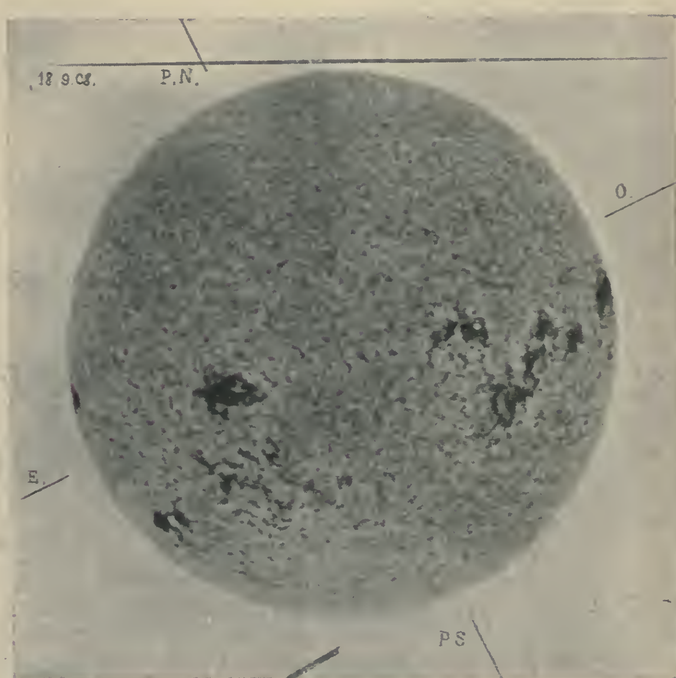
Jusqu'alors les spectrohéliographes employés isolaient en même temps l'ensemble des deux composantes brillantes de K_2 qui comprennent la raie K_3, avec une fente de $\frac{20}{100}$ d'Angström. L'image, appelée par nous image K_{23}, était un mélange des couches K_2 et K_3 avec une prédominance de la couche K_2, beaucoup plus brillante; la couche supérieure K_3 était masquée. Or, avec le grand spectrohéliographe, nous avons pu isoler facilement avec des fentes de $\frac{3}{100}$ d'Angström et plus, isoler soit la raie K_2, soit l'une des composantes de K_3, et avoir ainsi des images de chaque couche bien pures et exemptes de toute lumière étrangère. Les fentes correspondantes sont indiquées sur la Fig. 1 par des traits avec hachures.

La vapeur de calcium qui au bord extérieur, s'élève plus que toute les autres, présente ainsi dans l'atmosphère trois couches distinctes superposées. Si on ajoute la surface, on a quatre couches, qu'il est intéressant de comparer.

Lorsqu'on s'élève à partir de la surface, les facules ou plages brillantes de cette surface augmentent progressivement en étendue et en éclat relatif. Les flocculi moyens augmentent aussi, alorsque les petits disparaissent ou sont à peine visibles. Il en résulte un aspect particulier de la couche K_3 qui à première vue se distingue de la couche K_2, photographiée depuis 1892. (Voir les deux images K_3 et K_2, du 18 septembre 1908.) J'ajoute que le réseau spécial de flocculi, appelé par moi en 1894 *réseau chromosphérique*, et formé souvent, sur une étendue notable, de polygones juxtaposés par leurs côtés et leurs sommets, est en général plus net dans la couche supérieure.



Couche supérieure K_3 du calcium.



Couche moyenne K_2 du calcium.

PLATE I.—Images du 18 septembre, 1908.

D'autre part les taches noires, qui sont le caractère principal de la surface, diminuent progressivement, lorsqu'on s'élève et même disparaissent.

Par contre apparaissent des lignes noires, invisibles dans les couches basses, lignes souvent très longues et appelées par moi *filaments*. En général le filament est prolongé de chaque côté jusqu'au bord par d'autres lignes similaires, moins noires, moins nettes, appelées *alignements*. L'ensemble des filaments et alignements forme un véritable réseau sur le disque de soleil. Les filaments et les alignements sont un phénomène nouveau, caractéristique des couches supérieures.

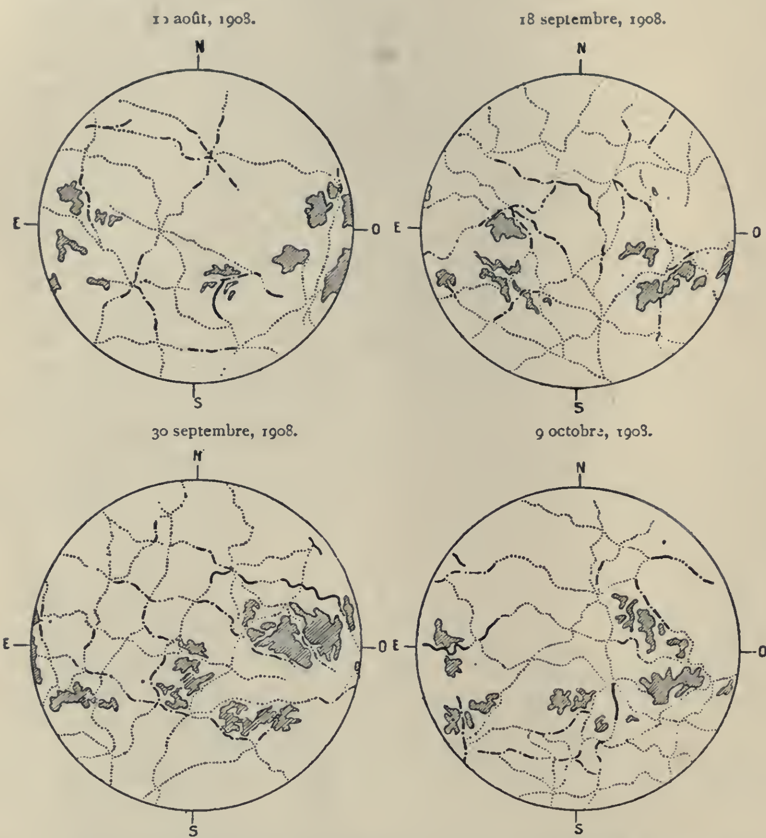


FIG. 3.—Réseau d'alignements relevé dans la couche supérieure de l'atmosphère solaire. Les traits noirs pleins correspondent aux alignements noirs, continues et très nets, appelés *filaments*; les traits discontinus aux alignements similaires moins nets, et les traits pointillés aux alignements encore moins visibles et parfois discontinus. Les parties hachées sont les plages brillantes faculaires les plus larges.

Le filament a la même importance que la tache de la surface; il persiste, comme elle, pendant plusieurs rotations et, comme elle aussi, il est le siége de perturbations spéciales, et est accompagné de proéminences.

Dans une première étude j'ai assimilé les taches aux dépressions ou cyclones de notre atmosphère, et les filaments aux anti-cyclones; mais je reviendrai plus loin sur ce rapprochement, qui sera developpé.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The degree committee of the special board for biology and geology has co-opted Dr. Barclay-Smith and Mr. R. H. Rastall as additional members of the committee.

The special board for physics and chemistry has appointed Mr. C. T. Heycock as assessor in chemistry to the examiners for the Mechanical Sciences Tripos in 1911.

Mr. George Winfield has been elected to the Benn W. Levy studentship.

The director of the observatory gives notice that on fine and clear Saturday evenings during the Lent full term celestial objects will be shown through the Northumberland equatorial to any members of the University and their friends who will come to the observatory between 8 and 10.30 p.m.

THE most important resolution of the last Muslim Education Conference, says the *Pioneer Mail*, related to an appeal to Muslims for a fund to raise the Aligarh College to the status of a Muslim university. The promoters of the scheme hope that if requisite funds are forthcoming a Muslim appeal for a charter from King George when he goes to India will not fail. His Highness the Aga Khan has given a lakh of rupees, and other important donations are promised.

A COPY of the report of the president of the Johns Hopkins University, Baltimore, U.S.A., for the year ending August 31, 1910, has reached us. It contains a brief summary of the principal events in the history of the University during the academic year under review, together with reports by professors and others having charge of the work in the various departments of the University. There seemed, at the date of the president's report, every probability that the University will benefit by the offer of the General Education Board to contribute towards the endowment fund the sum of 50,000*l.*, "provided that on or before December 31, 1910, a supplementary sum of not less than 150,000*l.* shall be contributed to the University in cash or pledged to the same by good and responsible persons in legally valid subscriptions, payable in cash in not more than three equal annual instalments." At the conclusion of his report the president, Prof. Ira Remsen, writes:—"At the time of this printing the signs are most favourable."

THE annual report of University College, Reading, presented at the annual court of governors on January 21, pointed out that the number of students studying for university degrees shows an increase from 95 in the session 1908–9 to 117 in the session 1909–10. The other students number 1007. There is a deficit on the year's working of 2016*l.* The principal of the college, Mr. W. M. Childs, told the court that two years ago the college had a total indebtedness on the new buildings of nearly 30,000*l.*, but owing to munificent anonymous donations last year, amounting to 16,500*l.*, that debt has been brought almost to vanishing point. In addition, Lady Wantage has provided a permanent endowment for Wantage Hall, which she presented to the college some years ago, and that will not only help to defray the cost of maintenance and equipment, but will probably provide for scholarships and bursaries, tenable at the college and the hall. Mr. G. W. Palmer has granted the lease of a recreation ground for twenty-one years rent free, and, thanks to Mr. Alfred Palmer, a new hall will soon be opened for women students.

THE annual meeting of the Association of Technical Institutions will be held, by the courtesy of the Stationers' Company, at their hall on Friday and Saturday, February 10 and 11. The company are generously entertaining the members of the association and a few special guests to luncheon on the Friday. In the afternoon a vote of thanks will be accorded to Dr. R. T. Glazebrook, F.R.S., the retiring president, for his services during the year 1910, and Dr. Glazebrook will move "that Sir Henry F.

Hibbert be elected president for the year 1911." Sir Henry Hibbert will deliver his presidential address upon "The Duties and Difficulties of Education Authorities so far as Regards Evening Continuation Schools." The formal business of the association will then be transacted, including the election of the officers and council. On Saturday morning there will be two discussions, one upon the Board of Education's new regulations for the registration of evening and other students, to be opened by Messrs. Crowther, Graham, and Sumpner, and the other upon the course system, to be opened by Messrs. Coles, Duthie, and Graham.

In a message from Cape Town, a *Times* correspondent points out that the agenda paper for the forthcoming Imperial Education Conference includes a large number of questions particularly concerning South Africa. Dr. Muir, F.R.S., the superintendent-general of education in the Cape Province, has suggested the following subjects, which it is expected will be discussed:—school curricula; bilingualism in the case of white children; the boy-scout movement and its relation to nature-study; problems connected with the education of aborigines; the collection and dissemination of information regarding the cost of instruction and cost of living in connection with advanced technical colleges and post-graduate departments of universities; the desirability of the formation of a permanent imperial education bureau; and arrangements for the mutual recognition of teachers' certificates. The director of education for the Transvaal has proposed for discussion the problems arising from the use of two languages as media of instruction, and the organisation of education in sparsely populated districts. In addition, one suggestion each from Nova Scotia and Sierra Leone has been received, so that it would appear likely that great prominence will be given at the conference to South African educational needs.

Copies of the general and departmental reports for the session 1909–10 of the Bradford Technical College have been received. We notice that the total number of students in attendance during the session under review was slightly greater than in 1908–9, and that the college is in the front rank in the country as regards the number of day students in attendance. It is anticipated that the additional facilities provided in the new buildings, which are now approaching completion, will result in a decided increase in the number of such students. A gratifying feature of all the reports is the information provided showing the interest in the college of the various manufacturers in the district. Their gifts towards the equipment of the different departments and the other assistance given by them to the principal and his staff are evidences of their desire to make the college a centre for the technical education of their workmen. Though the regularity of attendance of evening students has been well maintained, there are, the principal points out, many causes of irregular attendance, the chief of which are overtime in the mills, changes of residence, and ill-health. It is not probable, he says, that a higher percentage attendance can be attained until the question of the overtime work of students is dealt with by legislation or in some other general manner. The large and increasing amount of testing and experimental investigation carried out in the engineering department for local firms and for trade purposes is further evidence of the close connection between the work of the college and the industries of the neighbourhood.

SOCIETIES AND ACADEMIES.

London.

Royal Society, January 19.—Sir Archibald Geikie, K.C.B., president, in the chair.—G. S. **Walpole**: The action of *B. lactis aerogenes* on glucose and mannitol. Part ii. The "crude glycol" obtained by the action of *B. lactis aerogenes* on glucose contains two optically inactive 2:3-butane diols, the diphenylurethanes of which melt at 199·5° and 157° respectively. The former constitutes well over 90 per cent. of the material. If fructose be substituted for glucose in one of the flasks, the yield of "crude butylene glycol" and acetylmethyl carbinol is of the same order as when glucose is employed. Acetylmethyl carbinol is formed abundantly when the bacillus is cultivated in a solution of butylene glycol in 1 per cent. peptone in a current of oxygen.—Dr. W. E. **Dixon**: The pharmacological action of *Gonioma Kamassi* (South African boxwood). South African boxwood, *Gonioma Kamassi*, has been employed occasionally in Lancashire as a substitute for common boxwood in the manufacture of shuttles; it is stated that symptoms of poisoning have occurred in a small proportion of the men engaged in sawing this wood or finishing the chiselled shuttles. From the wood an alkaloid can be obtained to about 0·07 per cent. This has a very characteristic physiological action, which places it in the curare group of drugs. The members of this group may be regarded as possessing three actions in common:—(1) paralysis of certain nerve cells; (2) increase of spinal and medullary reflexes; (3) paralysis of motor nerve endings. Boxwood exerts all these effects. It paralyses the nerve cells in the brain and medulla, as well as those on the course of the vagus and sympathetic nerves, and therefore after its exhibition to animals the stimulant action of nicotine cannot be obtained. In small doses the reflexes are increased, and if an injection be made into a vein going to the spinal cord of an animal, strychnine-like convulsions are produced. Boxwood causes death by paralysing the respiration; this is central in origin, but it occurs at a time when the phrenics and intercostals are depressed, though not paralysed. Boxwood has no direct action on the heart or on other form of muscle. Reasons are given for believing that the recorded cases of poisoning are not due to the specific action of the drug after absorption, but to the effect of the drug in facilitating certain local reflexes, principally of a respiratory nature, in the predisposed.—Dr. W. **Yorke**: Autoagglutination of red blood cells in trypanosomiasis. Autoagglutinin exists in small quantity in the blood of many normal animals. It is frequently present in much greater quantity in the blood of animals infected with trypanosomes. Reaction between autoagglutinin and erythrocytes takes place only at low temperatures. The strongest reactions are obtained when a suspension of washed erythrocytes in normal saline solution is treated at 0° C. with plasma, which has been prepared by defibrinating blood at 37° C. Autoagglutinin can be removed from plasma by absorption with the erythrocytes of the same animal. The reaction between autoagglutinin and red blood cells is reversible, the clumps disappearing on warming and reappearing on cooling. Iso- and hetero-agglutinin are also often present in much greater amount in the blood of infected animals than in that of normal animals of the same species. From the red blood cells of an infected animal, which have been agglutinated in the cold by the plasma of the same animal, an active substance can be extracted with normal saline solution at 37° C. This substance agglutinates, not only the red cells of the same animal and other members of the same species, but also those of many animals of different species. Observations of this kind indicate that auto-, iso-, and hetero-agglutinin are not different highly specific substances, but have closely related affinities. That a clumping together of the red blood cells is frequently observable in coverslip preparations of the fresh blood of animals and man infected with trypanosomiasis is due to the existence of an excess of autoagglutinin in the plasma, which reacts with the erythrocytes to a certain extent at the temperature (15°–20° C.) at which the preparations are usually made. It is to be inferred from the information at present available that a marked degree of autoagglutination of red blood cells is an extremely rare occurrence apart from an infection with trypanosomes. The phenomenon is therefore of some value as a diagnostic sign.—M. **Nierenstein**: The transformation of proteids into fats during the ripening of cheese (preliminary communication). Contrary to the accepted view, it was found that the so-called ripening of cheese is not accompanied by a transformation of proteids into fats, the increase of weight of the latter, as observed by other workers, being due to the presence of *free cholesterol, aminovaleric acid, putrescine, and cadaverine* in the etherial extract. This investigation disproves one of the frequently quoted evidences in favour of the theory that proteids serve as a source for the fat-formation in the animal body.—J. F.

Gaskell: The action of X-rays on the developing chick. No difference was observed in the action of X-rays upon any one tissue rather than another. The action is confined to the lowering of the mitotic activity of the growing tissues. If this diminution is not too great, complete recovery occurs, and the chicks hatch out at the usual time. If the diminution is above a certain degree, recovery does not take place, and further development is arrested forthwith. The critical dose, which just prevents recovery, varies with the stage of development of the embryo, decreasing as the mitotic index decreases. The "mitotic index" as defined by Minot represents the number of mitoses per 1000 cells in the various tissues of embryos of various ages, and he has shown that throughout embryonic life a rapid diminution of mitotic activity is going on. He calls the figures obtained the mitotic index for that particular tissue.—Colonel Sir David **Bruce** and Captains A. E. **Hamerton** and H. R. **Bateman.** (Sleeping Sickness Commission of the Royal Society, Uganda, 1908–10.) Experiments to ascertain if antelope may act as a reservoir of the virus of sleeping sickness (*Trypanosoma gambiense*). It is known that the tsetse-flies (*Glossina palpalis*) around the northern shores of the Victoria Nyanza still retain their infectivity for sleeping sickness, in spite of the fact that the native population was removed from the lake-shore some three years ago. A series of experiments was, therefore, carried out to ascertain if the antelope, which are fairly common along the uninhabited shores of the lake, were capable of acting as hosts of the parasite of sleeping sickness. Eleven antelope of the waterbuck, bushbuck, and reedbuck species were obtained from a district where tsetse-flies and sleeping sickness did not exist. Blood from these animals was first inoculated into monkeys to ascertain if they were already naturally infected with trypanosome disease. They proved to be healthy in this respect. Tsetse-flies (*Glossina palpalis*) that were known to be infected with the virus of sleeping sickness were then fed upon each of the eleven antelope. After about eight days the blood of these animals was again inoculated into susceptible animals, with the result that the latter became infected with *Trypanosoma gambiense* in every case. In eight out of the eleven buck under experiment *Trypanosoma gambiense* appeared in their blood for a few days only (some seven to twelve days) after they had been bitten by infected flies. Flies that were hatched out in the laboratory, and had never fed before, were now fed upon the infected antelope, and subsequently upon monkeys. After an interval of about thirty days, required for the development of trypanosomes within the fly, monkeys were infected with sleeping sickness from the antelope by the agency of *Glossina palpalis* in sixteen out of twenty-four experiments. On dissecting the flies which had been fed upon the infected antelope, it was found that 10·8 per cent. of them were infected with *Trypanosoma gambiense*. The highest percentage of infected flies in any one of the positive experiments was 21 per cent.; the lowest was 1·3 per cent. Nine of these antelope infected with *Trypanosoma gambiense* were under daily observation for more than four months. They remained in perfect health. Two of them (a waterbuck and a bushbuck) never showed trypanosomes in their blood, although examined every day. Both these antelope-infected flies fed upon them, one of them as long as fifty-five days after its infection. No wild antelope inhabiting the lake-shore has yet been found to be naturally infected with *Trypanosoma gambiense*.—Colonel Sir David **Bruce** and Captains A. E. **Hamerton** and H. R. **Bateman.** (Sleeping Sickness Commission of the Royal Society, Uganda, 1908–10.) Experiments to ascertain if the domestic fowl of Uganda may act as a reservoir of the virus of sleeping sickness (*Trypanosoma gambiense*). There is evidence that tsetse-flies (*Glossina palpalis*) feed on the blood of birds as well as that of mammals inhabiting the shores of Victoria Nyanza. Domestic fowls, as representing birds, were experimented with in the search for possible hosts or reservoirs of the virus of sleeping sickness. A series of twenty-one experiments was carried out to ascertain:—(1) if these birds can, like antelope, be infected with *Trypanosoma gambiense* by the bites of known infected flies; (2) if birds so infected can transmit the parasite to newly hatched *Glossina palpalis* which had not fed before they were allowed to bite the fowls; (3) if these flies can convey sleeping sickness to normal monkeys. About 2000 flies, many of which had been proved to be infected with virulent *Trypanosoma gambiense*, were fed upon twenty-one domestic fowls. The results were negative in every case, as ascertained by frequent microscopical examination of peripheral and centrifuged heart's blood, and inoculations of the fowls' blood into susceptible animals. Four hundred newly hatched flies were fed upon three of the fowls which had been bitten by infected flies. The former were subsequently fed upon monkeys, with the result that they failed to convey sleeping sickness from fowls to monkeys. Two hundred and eighty-three of these flies were dissected, and no flagellates could be found in them. *Conclusion.*—The Uganda fowl cannot act as a reservoir of the virus of sleeping sickness.

Institute of Metals, January 18.—G. D. **Bengough**: Report to the corrosion committee on the present state of our knowledge of the corrosion of non-ferrous metals and alloys, with suggestions for a research into the causes of the corrosion of brass condenser tubes by sea water. The report is intended to be a general review of present knowledge of the subject of the corrosion of non-ferrous metals, both in its practical and scientific aspects. The theory of corrosion is considered in some detail, and an attempt is made to lay a broader scientific foundation for the whole subject. Two series of experiments are proposed, which, in the author's opinion, should be taken in hand at once. One series is of an empirical nature, and is intended to test the validity of certain opinions held on the subject by practical men, and especially such opinions as are in dispute between different authorities. The other series of experiments is of a purely scientific nature, and is regarded as a means of elucidating certain causes of corrosion that have hitherto been obscure.—Engineer Rear-Admiral J. T. **Corner**: Some practical experience with corrosion of metals. Some of the causes of corrosion of metals on shipboard are so obscure, and the origin so difficult to trace, that a satisfactory explanation is seldom forthcoming. Corrosion of a minor character existed in the old wooden warships, but when iron was used for shipbuilding the conditions were different, and it was soon found that the ships' plates and angles suffered from contact with the copper pipes and bilge water, the *Megaera* being a case in point, where the copper so affected the ship as to necessitate beaching her to prevent her sinking. Trouble from corrosion largely increased about the time of the introduction of the electric light afloat. Suggested causes of corrosion were considered.—Prof. H. C. H. **Carpenter** and C. A. **Edwards**: A new critical point in copper-zinc alloys: its interpretation and influence on their properties, with an appendix, by C. A. **Edwards**, on the nature of solid solutions. A new critical point has been found in those alloys of copper-zinc which contain the β constituent. The temperature of this point is 470° C. The physical meaning of this change is that the β constituent decomposes at 470° C. into the α and γ constituents. In the appendix to the paper, Mr. C. A. Edwards concludes that a metallic crystalline mass, often described as a solid solution, is an intimate crystalline mixture, and whilst the primary crystals are so small that the mass appears quite homogeneous when viewed under the microscope, they are sufficiently large to retain their identity.—Prof. A. **McWilliam** and W. R. **Barclay**: The adhesion of electro-deposited silver in relation to the nature of the German silver basis metal. This paper gives details of researches undertaken with the view of determining the nature of the adhesion of electro-deposited silver to the German silver alloys generally used as a basis metal, and whether any differences exist between various grades of alloys as to their suitability for use in the manufacture of electro-plate which may be called upon to withstand rough usage. The authors find that under the severest conditions of wear there is a great tendency for thick electro-deposited silver coatings to strip from the alloys of high nickel contents known as firsts, that the plating adheres most firmly to the lowest grades known as fifths, but as these are generally too soft or too weak for the special purpose, the best medium is found somewhere in the region of the alloys known as thirds.—H. J.

Humphries and Prof. C. A. **Smith**: Some tests on white anti-friction bearing metals. The authors, being persuaded that friction tests on bearing metals as usually conducted are for many reasons inconclusive, have endeavoured to stimulate a search for a series of static tests which shall be conclusive.

MANCHESTER.

Literary and Philosophical Society, December 13, 1910.—Mr. Francis Jones, president, in the chair.—Miss Margaret C. **March**: Preliminary note on *Unio pictorum*, *U. tumidus*, and *Onodonta cygnea*. The form of the British Unionids can be shown to be dependent on current and soil, and is therefore useless for systematic purposes when taken alone. The umbonal markings of these animals, merge into one another, and are therefore useless specifically. Phylogenetically they show that *U. pictorum* is most archaic, Anodon least, Tumidus being intermediate. The edentulousness of American Anodons illustrates heterogeneric homæomorphy. The ornament and dentition of Unionoids show relationship to Trigonids, and a descent from a pre-trigonid ancestor.—D. M. S. **Watson**: Notes on some British Mesozoic crocodiles. The author discussed some systematic and nomenclatural difficulties, recording the occurrence of a new variety of *Metriorhynchus hastifer* in the Corallian of Headington, of *M. hastifer* itself in the Kimmeridge clay of Britain, and discussing *Petrosuchus laevidens* and *Steneosaurus Stephani*.—Prof. F. E. **Weiss**: Sigillaria and Stigmariopsis. The author exhibited some specimens of axes of Sigillaria associated with Stigmarian bark. From the repeated occurrence of these specimens it was suggested that they represented the base of the aërial or the subterranean axes of Sigillaria, probably of the Eusigillaria type. The secondary wood was more copiously developed than is general in the aërial axes. The primary wood was of Sigillarian type, so that these Stigmarian axes have centripetal primary wood, and their pithcasts would be striated like those described for Stigmariopsis. It was noticed that in some instances small axes were found in contiguity, and apparently in continuity, with the main axes. These smaller axes resemble the ordinary Stigmarian axes very nearly, and do not show the centripetal primary wood of the main axis, but only a few fine tracheids in the pith region.

January 10.—Mr. Francis Jones, president, in the chair. —H. S. **Holden**: An abnormal fertile spike of *Ophioglossum vulgatum*. The spike in question exhibited a branching structure comparable to a certain extent with the condition normally characterising *Oph. palmatum*. The various features of the vegetative anatomy all serve to demonstrate that the condition described has arisen by a process of chorisis or splitting, thus confirming the work of Prof. Bower on the group to which the genus belongs.—Dr. A. N. **Meldrum**: The development of the atomic theory: (4) Dalton's physical atomic theory. The physical atomic theory, otherwise the theory of "mixed gases," is specially interesting because it marks a stage in the development of Dalton's ideas. Both it and the experiments connected with it arose out of the meteorological observations and studies of his early life. It reveals him as a student of Newton, and as the upholder of a physical atomic theory years before he formed the chemical one. Dalton's theory of mixed gases was an attempt to explain the diffusion of gases, especially of the oxygen and nitrogen in the atmosphere. He ascribed diffusion to physical forces, and not to chemical union, then the accepted explanation in nearly all quarters. In the course of the mixed gases controversy, Dalton had the support of William Henry only, whilst his opponents, who held that the diffusion of gases was due to chemical affinity, included C. L. Berthollet, John Gough, Thomas Thomson, and Humphrey Davy. The water vapour in the atmosphere is a special case of the mixed gases question. Dalton made observations of the dew-point, and used them as a measure of the water vapour in the atmosphere. In this way he raised "hygrometry to the rank of an exact science." Dalton expressly alluded to the hypothesis now associated with the name of Avogadro as a possibility, but rejected it on the ground that, if it were true, the density of a compound gas must be greater than that of its constituent elements, which was not always the case. He knew that nitric oxide and water vapour are lighter than the oxygen they contain.

PARIS.

Academy of Sciences, January 16.—M. Armand Gautier in the chair.—C. **Guichard**: Surfaces the normals of which touch a quadric.—Gaston **Darboux**: Remarks on the preceding communication.—E. **Cahen**: Prime (*intégro-entières*) series.—M. **Girardville**: Increasing the stability of aëroplanes by means of gyroscopes. The gyroscope used in these experiments had a rotating mass of 5·8 kilograms, and a velocity of rotation of 6000 turns a minute. Model aëroplanes, used as gliders without motors, when fitted with the gyroscope governor were found to be free from periodic oscillations, and re-established equilibrium when disturbed.—J. A. **Le Bel**: A singular heating of thin patinum wires.—A. **Cotton**: The delicacy of intereference measurements and the means of increasing them. Shadow interference apparatus. The delicacy of the ordinary interference methods is much increased by the use of polarised light, and means are suggested for applying this to the determination of double refraction.—Jacques **Boselli**: The resistance to the movement of small non-spherical bodies in a fluid. Stoke's theorem has been successfully applied to the study of the movement of spherical bodies in a fluid; in the present paper the motion of red blood corpuscles has been studied. Using the corpuscles of different shapes derived from the blood of different animals, it has been found that, other conditions remaining the same, the velocity of fall is inversely proportional to the viscosity.—M. **de Broglie** and L. **Brizard**: The radiation of quinine sulphate. Ionisation and luminescence. As a working hypothesis it is suggested that the scintillations, and perhaps the continuous light, are due to small electric discharges produced at the moment of the sudden breaking of small crystals.—M. **Hanriot**: Brown gold. This name is applied to the product resulting from the action of acid upon a gold-silver alloy. A study of the changes in volume produced in this modification of gold by increase of temperature. —G. **Urbain**: A new element accompanying lutecium and scandium in the gadolinite earths. Celtium. From the rare earths obtained by treating xenotime on the large scale, impure ytterbium was extracted, and by the fractionation of this a new element, lutecium, was isolated. With the view of obtaining larger amounts of lutecium, large quantities of gadolinite have been worked up. The mother liquor resulting from a series of fractional crystallisations from nitric acid contains a metal the oxide of which is characterised by a very low coefficient of magnetisation. Spectrographic analysis revealed the presence of lutecium, scandium, and traces of neoytterbium, calcium and magnesium, and a large number of new lines due to a new element, for which the name of celtium is proposed.—R. **Fourtau**: The metalliferous layer of Gebel-Roussas (Egypt). A detailed description of the zinc and lead deposits.—MM. **Melchissédec** and **Frossard**: The buccal resonator.—M. **Doyon**, A. **Morel**, and A. **Policard**: The isolation of hepatic antithrombine, with a description of some of its properties.—Gabriel **Bertrand** and F. **Rogozinski**: Hæmoglobin as a peroxydase. The compounds of hæmoglobin with oxygen, carbon monoxide, and hydrocyanic acid, were compared as regards their action as oxydases; the catalytic power of each of these compounds was found to be exactly the same.—Aug. **Michel**: Autotomy and regeneration of the bodies and elytra in the Polynoïdians.—J. **Granier** and L. **Boule**: The somatic kineses in *Endymion nutans*.—L. **Spillman** and L. **Bruntz**: The eliminating *rôle* of the leucocytes. The elimination of liquid substances foreign to the organism is effected in three phases: fixation, during which the liquids are fixed mechanically by certain forms of leucocytes: transport, the white corpuscles carrying the fixed substances to the excretory organs; excretion, the excretory organs taking possession of the products fixed by the leucocytes by a glandular process.—H. **Coutière**: The Eucyphote shrimps collected in 1910 with the Bourée net by the *Princesse Alice*.—E. **Roubaud**: The biology and pæcilogonic viviparity of the cattle-fly in tropical Africa (*Musca corvina*).—Ph. **Glangeaud**: The volcanic region of Forez and its rocks. In the Forez region during the Miocene or early Pliocene period more than eighty volcanoes were active. The lavas from these show numerous points of similarity with those of Limogne, Mt. Dore, and Velay.

MELBOURNE.

Royal Society of Victoria, December 28, 1910.—Prof. E. W. Skeats in the chair.—Bertha **Rees**: The structure of the seed coats of hard seeds, and their longevity. The paper deals mainly with the investigation into the nature of the impermeable layer of hard seeds. The cuticularised layer may consist either of culticle alone or may extend to a varying depth in the wall of the superficial palisade cells. The cuticle is usually deposited on a basis of hemicellulose, but in *Acacia melanoxylon* the basis is pectose.—Janet W. **Raff**: Protozoa parasitic in the large intestine of Australian frogs, part i. *Hyla aurea, H. ewingii, H. peronii, Limnodynastes dorsalis,* and *L. tasmaniensis* were examined. The forms found most commonly were *Nyctotheus cordiformis, Opalina intestinalis,* two new species of Opalina, *Copromonas subtilis, Trichomonas batrachorum,* and *Trichomastix batrachorum.*—J. T. **Jutson**: The structure and general geology of the Warrandyte goldfield and adjacent country.—J. T. **Jutson**: A contribution to the physiography of the Yarra River and Dandenong Creek basins, Victoria. The Yarra Flats area and its extension south through Croydon and Port Phillip Bay is a Senkungsfeld. The Nillumbik peneplain was uplifted so gradually that the Yarra kept its old course to Templestowe, and is antecedent to the present topography.—A. C. **Stone**: The aborigines of Lake Boga, Victoria. The paper consists principally of vocabularies and folklore.—F. **Chapman**: Some supposed pyritised sponges from Queensland. Two melon-shaped masses are compared externally with Lithistid sponges. They are probably of Desert Sandstone (Upper Cretaceous age).—F. **Chapman**: A revision of the species of Limopsis in the Tertiary beds of southern Australia. Five species are recognised (*L. morningtonensis*, Pritchard; *L. maccoyi*, n.sp. = *L. belcheri*, M'Coy non Adams and Reeve; *L. multiradiata*, Tate; *L. beaumariensis*, n.sp. = ? *L. forskali*, Tate non Adams; and *L. insolita*, G. Sow). The latter also occurs in the Santa Cruz beds of Patagonia.—K. A. **Mickle**: The flotation of minerals. The metallurgical method of separation by flotation is due to an adherent gas film on the granules of ore. An account of a large series of experiments is given.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 26.

ROYAL SOCIETY, at 4.30.—Memoir on the Theory of the Partitions of Numbers. Part V.—Partitions in Two-dimensionals Space: Major P. A. MacMahon, F.R.S.—(1) The Origin of Magnetic Storms; (2) On the Periodicity of Sun-spots: Dr. A. Schuster, F.R.S.—Atmospheric Electricity over the Ocean: Dr. G. C. Simpson and C. S. Wright.—On the Fourier Constants of a Function: Dr. W. H. Young, F.R.S.—On the Energy and Distribution of Scattered Röntgen Radiation: J. A. Crowther.—On some new Facts connected with the Motion of Oscillating Water: Mrs. H. Ayrton.

ROYAL INSTITUTION, at 3.—Recent Progress in Astronomy: F. W. Dyson, F.R.S., Astronomer Royal.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Long Distance Transmission of Electrical Energy: W. T. Taylor.—Extra High Pressure Transmission Lines: R. Borlase Matthews and C. T. Wilkinson.

FRIDAY, JANUARY 27.

ROYAL INSTITUTION, at 9.—Radioactivity as a Kinetic Theory of a Fourth State of Matter: Prof. W. H. Bragg, F.R.S.

PHYSICAL SOCIETY, at 5 (at University College).—A Demonstration of Phase Difference between the Primary and Secondary Currents of a Transformer by means of a Simple Apparatus: Prof. F. T. Trouton, F.R.S.—A Note on the Experimental Measurement of the High Frequency Resistance of Wires: Prof. J. A. Fleming, F.R.S.—(1) The Measurement of Energy Losses in Condensers traversed by High Frequency Oscillations; (2) Some Resonance Curves taken with Impact and Spark Discharges: Prof. J. A. Fleming, F.R.S., and G. B. Dyke.—Council Meeting at 4.30 p.m.

SATURDAY, JANUARY 28.

ESSEX FIELD CLUB, at 6 (at Essex Museum of Natural History, Stratford).—Exhibition of Coloured Photographs of Alpine Flowering Plants: Somerville Hastings.—Note on the Occurrence of Stony Beds underlying Harwich Harbour: Percy Thompson.—On a Pre-historic Interment found near Walton-on-Naze: Hazzledine Warren.

MONDAY, JANUARY 30.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Recent Explorations in Dutch New Guinea: Dr. H. A. Lorentz.

INSTITUTE OF ACTUARIES, at 5.—On Staff Pension Funds: The Progress of the Accumulation of the Funds; The Identity of a Valuation with the Future Progress of a Fund; The Manner of Dealing with Funds which are Insolvent; and Sundry Observations: H. W. Manly.

TUESDAY, JANUARY 31.

ROYAL INSTITUTION, at 3.—Heredity: Prof. F. W. Mott, F.R.S.

ROYAL SOCIETY OF ARTS, at 4.30.—The Tin Resources of the Empire: F. Douglas Osborne.

ILLUMINATING ENGINEERING SOCIETY, at 8.—*Discussion* on Library Lighting opened by J. Duff Brown and S. L. Jast.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: Sand movements at Newcastle Entrance, N.S.W.: C. W. King.—Fremantle Harbour-works, Western Australia: C. S. R. Palmer.—The Bar Harbours of New South Wales: G. H. Halligan.

WEDNESDAY, FEBRUARY 1.

ROYAL SOCIETY OF ARTS, at 8.—Examinations and their Bearing on National Efficiency: P. J. Hartog.

SOCIETY OF PUBLIC ANALYSTS, at 8.—President's Annual Address.—Note on the Detection and Estimation of Small Quantities of Antimony: Dr. P. Schidrowitz and H. A. Goldsbrough.—The Analytical and Microscopical Examination of Compound Liquorice Powder: G. E. Scott-Smith and John Evans.—Commercial Analysis and Arithmetic: C. A. Seyler.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, FEBRUARY 2.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: (1) Experiments to investigate the Infectivity of *Glossina palpalis* Fed on Sleeping Sickness Patients under Treatment; (2) Experiments to Ascertain if *Trypanosoma gambiense* during its Development within *Glossina palpalis* is infective: Col. Sir D. Bruce, F.R.S., and others.—Further Experimental Researches on the Etiology of Endemic Goitre: Captain R. McCarrison.—On the Leaves of Calamites (*Calamocladus Section*): H. H. Thomas.—Complement Deviation in Mouse Carcinoma: Dr. J. O. W. Barratt.

ROYAL INSTITUTION, at 3.—Recent Progress in Astronomy: F. W. Dyson, F.R.S., Astronomer Royal.

LINNEAN SOCIETY, at 8.

RÖNTGEN SOCIETY, at 8.15.—The Work of Action of an Induction Coil: Prof. Salomonson.

FRIDAY, FEBRUARY 3.

ROYAL INSTITUTION, at 9.—Grouse Disease: A. E. Shipley, F.R.S.

GEOLOGISTS' ASSOCIATION, at 7.30.—Annual General Meeting.—President's Address: Flint and Chart: W. Hill.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Rivers and Estuaries: W. H. Hunter, M.Inst.C.E.

CONTENTS.

THURSDAY, FEBRUARY 2, 1911.

THE ENCYCLOPÆDIA BRITANNICA.

The Encyclopaedia Britannica: A Dictionary of Arts, Sciences, Literature, and General Information. Eleventh edition. Vols. i.–xiv. (A—Italic.) (Cambridge: University Press, 1910.)

THE Encyclopædia Britannica is of Scottish birth. Its first edition appears in 1771. Its interesting and rather chequered history occupies some three pages of the present (eleventh) edition, and shows its intimate connection with the land of its birth until the reprint of the ninth edition issued by *The Times* in 1898. Under the same auspices the eleven-volume supplement to the ninth edition was issued, and, together with that edition, formed the tenth, in 1902, and it is not a little curious to observe that the impression created by that issue appears to have been so strong that few realise off-hand that the present new edition has occupied eight years in the making. Its preparation continued to be conducted from the office of *The Times* until 1909, when the rights of publication were taken over by the Cambridge University Press, a step generally acknowledged to be peculiarly appropriate to the character of the work. It is proposed in the present general notice to consider some of the most notable characteristics of the work, such as distinguish it from former editions and from other works of reference. For that it possesses such characteristics cannot be questioned; the new edition shows evidence of much more than a simple reliance upon traditional form.

Probably the two leading ideals before the editorial staff in preparing the eleventh edition have been (1) to make the whole work easy of reference and self-explanatory, and (2) to ensure that every article should possess, so far as possible, a permanent value, giving preference (within reason) to the established fact over the statement of the moment or over prophecy. The Encyclopædia Britannica has been traditionally distinguished for certain individual features, such as a high literary standard and the existence of "omnibus" articles—practically complete treatises—on each great main division of knowledge. The simple addition of many short separate articles, while sufficient to make reference easier, might have tended to obscure the literary standard and to duplicate the information contained in the omnibus articles. But the old omnibus article could not always be self-explanatory; it could not guide the unlearned reader along the main line of his subject without taking him incidentally along the branches, whereas the specialist, desiring to find a particular branch, must follow up the main line to reach it. It has now been assumed that the principal function of such an omnibus article as "geology" is to indicate the main lines of that science, with free reference to branches of the subject dealt with more fully under separate headings. Thus the reader desirous of studying the glacial period now finds that heading in its own place, instead of having to search the treatise on geology for it. Again, not even the glacial period and the glacier itself fall under one general head, but each has its own. By this method it has been sought to ensure that the elementary student may find his elements, and the specialist his special subject, unobscured the one by the other. The single illustration given is that of a principle which has been applied so far as possible in every department of the work.

The introduction of what has been called the "dictionary feature" is of a piece with this same principle. There are very many terms which a specialist uses naturally without considering that they may call for explanation; especially there are many the meaning and connotation of which vary in general and in particular application. For such terms, and for many others in commonest use, the origin of which is peculiar or obscure, definitions on an etymological basis have been introduced—often a short separate article has been inserted for this purpose alone. This feature is an expression of the ideal of making the work self-explanatory.

The attempt to make every article as nearly as may be of permanent value has imposed a heavy responsibility on the editorial staff. The system of employing statistics offers an illustration. In the previous editions they were used very freely, and in many cases simply for their own sake, the reader being left to draw his own conclusions from them. It has now been felt that this practice (subject, of course, to the inclusion of certain essential figures like vital statistics) is far rather the function of an annual register than of an encyclopædia, and that the proper encyclopædic function of statistics is to illustrate statements of fact, so that they ought not as a rule to stand alone. They have, therefore, been used much more sparingly than before, and in many cases even without reference to the latest figures available, when others better illustrate the particular point under notice.

On more general grounds, it is always difficult to appraise a current event at its historical value, with due allowance for its momentary appeal to the minds of men. Here again the editorial responsibility has been heavy, the heavier owing to the almost simultaneous publication of the complete work. For it may be assumed, and ought to be remembered, that the copy for twenty-eight textual volumes of nearly a thousand pages each cannot be kept under the editorial hand until one month, or two months, or three, before the date of publication, and the order be then given to the printers. It may be taken for granted, for instance, that the article on the kingdom of Portugal was in its final form when the revolution created a republic instead, and much of the article must be recast. The result of the last general election was due on a certain day; the proper alphabetical place must be held open in the text to include that result, while the presses continued their work on either side of the waiting page. We recognise something of the journalistic method here, in the judgment as to which events of the moment are to be dealt with in this way and which are not, and the journalistic experience of the editor, Mr. Chisholm, must have stood him in good stead.

The simultaneous publication of the eleventh edition is a remarkable achievement in various obvious ways; it has certain less obvious bearings on the character

of the book. It should be a guarantee, for instance, of a well-balanced treatment of all subjects from A to Z. Not a few great works of reference, including the encyclopædia itself in former editions, appearing volume by volume over the period of a generation, have shown signs (so to speak) of fatigue in about the last quarter of the alphabet. In some instances it may have been financial fatigue, in others merely the realisation that the proportions of the first few volumes, if maintained, would bring the completed work to an impossible bulk. But the promise of simultaneous publication disposed of any such possibilities in the present edition, for in order to carry it out the cost must have been counted and the scheme laid out, not volume by volume, but for the whole work at once. And this treatment of the whole connotes the similar treatment of every part, not merely as regards the laying-out of each group of main and subsidiary articles, but as regards questions of general policy. The illustrations are a case in point. The editorial ideal has been to illustrate where illustration is a genuine assistance or supplement to textual description, and only in that way, not including pictures simply for their own sake. So every suggestion or possibility of illustration has been brought, so to say, under one standard test.

It is the same with the maps. The tenth edition set the precedent of an atlas volume. The editors of the eleventh have put this precedent aside. Their view may be open to criticism; there are undoubtedly arguments in favour of an atlas volume. But the advantage of having the article on each important territory accompanied by its appropriate map has been considered stronger. Moreover, the possibility of allocating to each such territorial article its map according to a graduated scale—double-plate, single-plate, or small text map, coloured map or black only—has given the geographical editors an opportunity in the direction of proportional treatment which would have been precluded by the construction of an atlas, at any rate of the size of an encyclopædia scheme. At the same time, the proper indexing of the maps has been undertaken, so that they may fulfil the atlas-function. Here the editorial ideal has been to set before the cartographers either the actual text of the articles to be illustrated or the most precise instructions as the scope and orthography of each map, to carry out the indexing in the editorial office, and to apply as part of that process a careful system of checking and correction. This method presupposes the manufacture of a complete series of new maps for the book; there has been no use of cartographers' stock.

Mention of map-indexing leads to the subject of text-indexing. The indexing of the tenth edition was a great conception, and of course added enormously to ease of reference. But it was an after-thought, whereas the work of preparing the index entries for the eleventh edition has proceeded concurrently with practically the whole work, the pagination being added at the last. It has been possible, therefore, to put the indexing to an editorial use, in this way—that when the index-references on any subject were put together, they have been found sometimes to indicate the existence of unnecessary duplications or of inconsistencies of view or even of fact, between articles by different authors—such duplications or inconsistencies as could not possibly have been discovered by any other editorial method.

The eleventh edition bears a clear international imprint. If the conception of certain articles dealing with subjects of world-wide interest be compared in this and former editions, evidence will be found of another editorial ideal. For example, on matters of government, sociology, law and the like, it has been sought to explain not British practice only, but American and foreign as well. The work has an extra-British reputation already; it has palpably been attempted to justify and increase that reputation. The multinational list of contributors illustrates the same ideal.

It has been said above that one tradition of the Encyclopædia Britannica is a high literary standard. This has been preserved. No man reads a dictionary or ordinary book of reference for its own sake as literature. The editors of such works have no room to offer their contributors any literary opportunity. But while it would be unfair to forget that the problem of the best utilisation of available space must have been as constantly present to the editor of the Encyclopædia Britannica as to the printer of a finger-prayer-book, the fact remains that twenty-eight large volumes do offer a literary opportunity; if they did not, they would not justify their existence. On any subject capable of literary treatment (and few are not) the Encyclopædia appears to apply that treatment; it is impossible to turn many pages (except one should light on such a topic as higher mathematics) without reaching some subject or fact which is presented so as to arouse the casual, as distinct from the special, interest. The India-paper edition makes it possible to do this without physical discomfort, and the production of that edition is in itself an unprecedented achievement, for it must necessarily presuppose that paper-mills of some half-a-dozen countries have been laid under contribution to meet a demand of such magnitude, and that the printing must have been carried out with a rapidity the possibility of which, as applying to India paper, was probably unrealised before. On these grounds the manufacture of the book must be pronounced admirable.

Such, then, have been some of the ideals of the editors and publishers. There is every evidence that they view the finished work with enthusiasm, knowing more than others can of the difficulties which have been overcome; judged upon these general grounds, their enthusiasm appears justified.

ELECTROMAGNETS.

Solenoids Electromagnets and Electromagnetic Windings. By Charles R. Underhill. Pp. xix + 342. (London: Constable and Co., Ltd., 1910.) Price 8*s*. net.

THIS is a book dealing generally with electromagnets, and so far as the author records experimental results will be found useful, but the explanation of the experiments is not given as fully as is desirable

in order that the reader may thoroughly understand the theoretical deductions, and the latter themselves are not always trustworthy. We find a good many quotations with due acknowledgment of articles that have appeared in the *Electrical World* of New York, and if the author had exercised some care in the selection his book could only have benefited by it. Unfortunately, however, the necessity of carefully probing the correctness and relevancy of any article before admitting it into his book does not seem to have occurred to the author, and the result is that we find statements in his book which often are quite useless and sometimes even unintelligible. To give only a few examples. On p. 152 is given a formula for the inductance of a solenoid for which an accuracy of half per cent. is claimed, but the author does not say whether the result is obtained in cm. or in Henry. Moreover, the formula is very cumbersome, and no proof is given. On the next page another formula is wrongly quoted from Maxwell, the exponent for the number of turns per cm. length being given as four instead of two. Also in this case the author does not state whether L is obtained in cm. or Henry.

Another example of the want of criticism on the author's part will be found on p. 32. Here he gives us Mr. H. S. Baker's method of expressing the degree of saturation of the core of an electromagnet. It is as follows:—Draw a tangent to the magnetisation curve at the point for which the degree of saturation is to be expressed as a ratio. Note the length cut off on the B axis by the point of intersection of this tangent. Then the ratio of this length to the value of B at the selected point gives the degree of saturation. Since the characteristic is nearly straight for high values of magnetisation, this method of expressing saturation leads to the absurd result that Baker's ratio becomes actually smaller for very high degrees of saturation. A rule of this kind is absolutely useless and even misleading, and a little consideration on the author's part would have shown him that he had better not include it in his book.

A very bad slip in scientific principles occurs on p. 16. There we are told in an equation that the "Intensity of magnetisation" divided by the magnetic moment gives the "Intensity of the magnetic field." This is quite wrong, for the ratio is simply the inverse of a volume. Again, on p. 25, we are told that

"the relation between the strength of a current in a wire and the intensity of the magnetic field or magnetising force is expressed by the equation $H=0{\cdot}2I/a$."

This is only true if the wire be infinitely long, but as in what precedes this statement not a word is said about the length of the wire the statement as it stands is misleading, and, in fact, meaningless.

Some of the terms used are not very familiar to English readers. The author talks of Maxwells, Gilberts, and Gausses, but these, although used occasionally by American writers, have never been sanctioned by the international committee on nomenclature. There is, moreover, no great necessity for multiplying such terms. It is just as easy to say two megalines as two million Maxwells, or an induction of 15,000 lines as an "induction of 15,000 Gausses." Why the "Oersted" as representing the magnetic reluctance of "one cubic centimetre of vacuum" should be introduced is also not very apparent. There is perhaps some excuse for the use of such terms in the fact that others have done so before, but the introduction of the term "activity" in substitution of the generally used and perfectly understood term "space factor" is surely quite superfluous. It will also puzzle the reader to say what a "water shield," a "stopped solenoid," and a "fringed insulation" are Such technical terms may be convenient for a particular workshop as short instruction to the workman, but a scientific book is not the place to use them.

On the very important question of heating of coils the information given is rather meagre. All we are told on p. 299 is that a

"coil of ordinary dimensions may remain in circuit continuously when the applied electrical power does not exceed 0·50 watt per square inch of superficial radiating surface."

A curious statement is made on p. 184 as regards the time constant of two coils in parallel. The author says that it is only one-quarter of the value for the coils in series, but he has evidently overlooked the fact that although the inductance is quartered, the resistance is also quartered and therefore the time constant remains the same. Gisbert Kapp.

ANALYSIS OF WINE AND OTHER SPIRITUOUS LIQUORS.

Traité complet d'analyse Chimique, appliquée aux essais industriels. By Prof. J. Post and Prof. B. Neumann. Deuxième edition Française, traduite d'après la troisième édition allemande. By G. Chenu et M. Pellet. Tome Second. Troisième Fascicule. Pp. 497–916. (Paris: A. Hermann et Fils, 1910.) Price 13 francs.

This part of Post and Neumann's work deals with alcoholic beverages and some allied products. Chiefly it is concerned with wine and beer, and the original German text has been largely supplemented by details of the French practice in the chemical surveillance of these articles. Thus Gallicised, the work is of special interest for those concerned with its subject, inasmuch as it represents the experience of two great wine-making countries and of one, at least, famed also for its beer.

Dr. P. Kulisch, of Colmar, is responsible for the original section dealing with wines; but in view of the importance of the subject in France considerable additions have been made by the French translators. The result may therefore be taken to indicate the best practice in the two countries. At the outset are given the definitions of wines and the descriptions of usual manufacturing operations adopted by the International Congress for the Repression of Food Adulteration (Geneva, 1908, and Paris, 1909). Then follow directions for the chemical determinations required during the preparation and fermentation of the grape-juice, and the official methods prescribed in France and in Germany for the analysis of the fermented product. Detailed notice would be unprofitable here; it must suffice to say that full directions are given for appraising the various vinous constituents. Numerous illus-

trations of apparatus are shown, as well as tables needed for the estimation of alcohol, sugar, and "extract."

For the benefit of local authorities and others in this country who are inclined to begrudge their analyst his fees, it may be remarked that the French prescriptions for the analysis of wine involve no fewer than nineteen separate experiments or determinations, whilst the German regulations require twelve for an ordinary full analysis and twenty-six in special cases.

Having carefully obtained his analytical results in any instance, how is the operator going to interpret them? Some data for this purpose are given in the text, but they are meagre, and might usefully be supplemented. Even to the experienced, a record of maximum and minimum values yielded with given methods by genuine wine of different types would often be of service.

One rather humiliating reflection is suggested on looking over the various modes of examining wine. The liquor "which maketh glad the heart of man" holds yet some secrets which elude his skill as a chemist. Much as chemistry has advanced since the days when Pasteur carried out his "*Etudes sur le vin,*" the palate is still an indispensable aid to such studies. Just as the chemistry of the living plant transcends in delicacy that of the laboratory, so the senses of smell and taste can discern, and in some sort evaluate, differences far too subtle for demonstration by balance, test-tube, or polarimeter. Not only for the finer distinctions between vintage wines, but even sometimes for detecting relatively gross adulteration, the organoleptic test of bouquet and aroma remains the best or the only criterion.

As regards beer, there is little described that would be new to a well-trained brewers' chemist. The section, however, gives a concise account of the operations necessary for the chemical control of brewery procedure, including the examination of water, barley, malt, hops, and wort, as well as the finished beer.

The various distilled spirits and the liqueurs are dealt with in an important division, which includes also an account of pressed yeast—now a notable by-product of alcohol distillation. Cider, perry, vinegar, acetic acid, and methyl alcohol are other subjects treated in the volume.

C. SIMMONDS.

PRACTICAL PATHOLOGY.

Practical Pathology. A Manual for Students and Practitioners. By Prof. G. Sims Woodhead. Fourth edition. Pp. xxii+798. (London: Henry Frowde and Hodder and Stoughton, 1910.) Price 31*s.* 6*d.* net.

THE practical pathology of to-day is very different from the practical pathology of twelve or fifteen years ago, when the third edition of this book was published. Nevertheless, the present edition, as regards the scope embraced by it, remains much as it was, viz., it is a guide for the post-mortem room and a manual of practical morbid anatomy and histology; general pathology, with the exception of inflammation, is almost untreated. Prof. Woodhead has, however, deliberately chosen this course, and in the preface explains that in its present form "Practical Pathology" has been found helpful to the medical student in his class and ward work, and to the practitioner who desires readily accessible data on the methods and information which it contains.

The first 150 pages are devoted to post-mortem examinations, and the methods of preparing tissues for microscopical investigation. A judicious selection has been made of the multitudinous methods for fixing, hardening, and staining that have been devised, and this part of the book should be most useful.

After this the phenomena occurring in inflammation are discussed, and then the morbid changes met with in the various tissues and organs are dealt with. This method, while having the advantage of taking the student through the principal alterations which occur in a particular organ when diseased, has the disadvantage that descriptions of processes which are very similar in the various organs, *e.g.* tuberculosis, are repeated again and again, with a consumption of space which might perhaps have been better utilised for other subjects which have been omitted.

On the whole, the descriptions of the histological appearances of morbid tissues are ample and accurate, and all the commoner conditions are dealt with. We fail to find any reference to endotheliomatous tumours, which of late have assumed some importance, and no mention is made of the differentiation of ovarian cystomata into two varieties, nor of the fact that the pseudo-mucinous cystadenoma on rupture frequently gives rise to metastatic growths of the peritoneum, which may become carcinomatous.

Nearly two pages are devoted to a description of the so-called parasites of cancer, but the student is not warned that the parasitic hypothesis of the genesis of cancer is now largely discredited, and that these so-called parasites may be peculiar forms of cell degeneration. Nor is any mention made of modern work on the cytology of malignant growths or of the apparent transformation of carcinoma into sarcoma by a metamorphosis and overgrowth of the connective-tissue stroma.

With a little amplification on these and other points by the teacher, the work should prove a most useful class book on practical morbid histology. The beautiful coloured drawings by Mr. Richard Muir and others are much to be commended, though occasionally (*e.g.* Fig. 265, Tertian malaria) more is depicted than will ever be found in any one specimen.

SYLVESTER'S MATHEMATICAL PAPERS.

The Collected Mathematical Papers of James Joseph Sylvester, F.R.S., &c. Vol. iii. (1870–83). Pp. xvi+688. (Cambridge: University Press, 1909.) Price 18*s.* net.

THE greater part of this volume consists of papers on the theory of algebraic forms, and their substance is now so familiar that it is needless to analyse them. But the reader who turns back to these classical memoirs is charmed, as ever, by the genius they display, and the extraordinary vivacity with which they are written. Moreover, Sylvester's habit of publishing in haste, while the hot fit was on

him, makes all his papers stimulating in a way which encourages research. His scattered hints and surmises, his digressions and scholia, his occasional fantastic notes, all add to the fascination of his work. Thus, to take an example quite at random, he concludes a paper on irreducible concomitants by remarking:—

"I have always thought and felt that beyond all others the algebraist, in his resarches, needs to be guided by the principle of faith, so well and philosophically defined as 'the substance of things hoped for, the evidence of things unseen.'"

This might as certainly be ascribed to Sylvester as a characteristic passage of "Sartor Resartus" to Carlyle.

One of the memoirs on quantics deserves particular notice; it is that which represents concomitants by graphic symbols, such as those used in organic chemistry. It is curious that this method, which at one time engrossed Clifford as well as Sylvester, should have been so barren in results. Perhaps the most interesting things in the paper are Sylvester's remarks on the possibility of algebraic theorems having corresponding propositions in chemistry; for instance, he says,

"Hermite's law of reciprocity . . . amounts to affirming in chemical language that in any compound an arbitrarily selected group of m n-adic atoms may be replaced by a group of n m-adic atoms; but how far this law of replacement has objective validity in the chemical sphere, I am not able to say."

Among the arithmetical papers, of which there are several, the longest, and one of the most interesting, is that on the diophantine equation $x^3+y^3=Az^3$. Although Sylvester did not reach so definite a result as that stated by Lucas, he considerably extended the theorems of Pépin, and the way in which he does this is of a strictly elementary kind. Besides this, he gives a beautiful proof of a fundamental theorem connected with "residuation" of points on a cubic curve; by the application of elliptic functions this can be done in a line or two, but Sylvester's demonstration is far more instructive.

Another paper of interest is that on the distribution of primes, in which he extends the method of Tchébicheff, while several scattered notes on partitions, Farey series, and the theory of vulgar fractions, contain hints which may very likely admit of development.

One definite suggestion may be mentioned here (*cf.* pp. 414–25). It is well known that Sylvester proved and generalised, Newton's rule for discriminating the roots of an equation $f(x)=0$. This rule employs the coefficients of f and also those of a derived function the coefficients of which are quadratic in those of f. Now the question is whether there may not be other derived functions, with coefficients formed by some simple rule, which may settle those cases in which Newton's rule is insufficient.

The care with which Dr. Baker performs his duty as editor again deserves cordial recognition; on pp. 357–8 the sign + in several places seems to be a misprint for −, and it is possible that a few other such mistakes may have been overlooked, but considering Sylvester's great inaccuracy in proof reading, the correctness of the text, so far as the present reviewer has been able to test it, is remarkable.

G. B. M.

NATURE-STUDY AND ROSE PESTS.

(1) *Battersea Park as a Centre for Nature Study*. By W. Johnson. Pp. 128+map. (Published under the direction of the Battersea and Wandsworth Educational Council.) (London: T. Fisher Unwin, 1910.) Price 1*s.* net.

(2) *How to Know the Trees*. By H. Irving. Pp. vi+179. (London: Cassell and Co., Ltd., 1910.) Price 3*s.* 6*d.* net.

(3) *Rosenkrankheiten und Rosenfeinde*. By Dr. K. Laubert and Dr. M. Schwartz. Pp. vi+59. (Jena: Gustav Fischer, 1910.) Price 1 mark.

THE pursuit of natural history observations on the part of children in towns can be in many ways more profitably directed in parks than in the open country, at any rate until such time as the children learn how and what to note. Proximity to the schools, the aggregation of many features within a small area, and opportunities for repeated visits all favour the systematic use of advantages offered by the London public parks. The chief opportunities for study in Battersea Park (1) are provided by the birds, both wild and cage-bound, insects, wild flowers, and trees. These themes are well elaborated by Mr. Johnson with a knowledge arising out of intimate acquaintance. In addition, there are chapters on history, geography, and set subjects for rambles, while other facts are collated in the outline calendar, and a map serves for general purposes, as well as for indicating the positions of the large trees. The volume represents an effective triple cooperation of an observant author, a well-guided educational council, and an interested publisher.

Although numerous books on trees are extant, it is doubtful whether any one of modest dimensions describes more precisely the ever-changing appearances and distinctive features of the trees than the volume provided by Mr. Irving (2). About sixty different kinds are described, some very briefly, when they are closely allied plants, as the various pines, others, as the ash, at great length, but in all cases full indications are furnished of distinguishing characters. The illustrations have appeared before, but they are so excellent that they bear repetition. The author introduces but few technical words, even to the extent of leaving out the scientific names of the trees; in the case of the Himalayan pine the scientific name is required for purposes of identification, and, generally speaking, they are desirable. The book can be thoroughly recommended.

In the volume on rose pests (3) Dr. Laubert deals with fungi, and distinguishes seven definite diseases. Rust, mildew, canker, and leaf blotch are the commonest, to which are added rot mould (*Peronospora sparsae*), a root disease (*Roesleria sp.*), and a Botrytis rot (*Sclerotinia Fuckeliana*). Two other diseases

of roses, leaf-spot (*Septoria rosae*) and tumour (*Botryosphaeria diplodia*) are not given. This part of the book might have been condensed with advantage. Dr. Schwartz has a more extensive task in describing the insect pests, of which more than a hundred are known. About fifty species are shortly described and tabulated according to the parts of the plants which they injure. The data given are as full as could be expected, and remedies are mentioned.

OUR BOOK SHELF.

Exercises in Metal Work. For Trade Preparatory Schools. By A. T. J. Kersey. Pp. x+70. (London: G. Bell and Sons, Ltd., 1910.) Price 1*s*. 6*d*. net.

TWENTY-SEVEN exercises in detail are contained in this book, and hints for continuing thereafter a course in metal-work suitable for pupils in trade preparatory schools. The exercises are carefully graduated, at first introducing the use of hand tools, and leading up to some simple exercises in the use of machine tools, such as drilling machines, shaping machines, and turning lathes. The drawings are good, and show in every case what is required of the pupil. Some little omissions occur here and there; for example, on p. 53 appear drawings of a V block as an example of the use of a shaping machine. It is customary to have a groove at the bottom of the V in order to facilitate finishing its faces; this has been omitted. It is not, however, a grave objection to find such details left out; students possessed of average intelligence will discover them, and, judging from the preface, it is more than probable that the author had this view before him in the production of the book.

We can commend heartily the reading of the author's preface to any teacher or other person having an interest in workshop classes. The value of a sympathetic teacher cannot be over-estimated; it is often difficult for an instructor who has been trained in an engineering works (and this is essential) to realise the difficulties of the boy who has just left the elementary school. Unless he bears in mind the mistakes and troubles of his own early apprentice days, he is apt to be impatient. Pupils should be encouraged to think out answers to home-work questions. Those appearing in the book are designed with the view of cultivating the spirit of inquiry and of teaching pupils to think about their work, as mere manipulative skill is of little value without this—the true aim of all education, technical or otherwise. We can commend this book as an intelligent attempt to assist in carrying out these broad-minded principles.

A Lecture on Mendelism. By Dr. H. Drinkwater, F.R.S. Pp. iii+31. (London: J. M. Dent and Sons, Ltd., 1910.)

IN this book is given a popular lecture on Mendelian heredity, printed apparently with hardly any alteration; and considered as a lecture it is distinctly good. It is very simply and clearly written, and with the help of the numerous diagrams and figures should make the main outlines of the subject clear to those who have no previous acquaintance with it. It has, however, the unavoidable defect of a lecture, that to avoid confusion essentials must be emphasised to the exclusion of the less important; it would probably have been improved by the addition of footnotes in some places, amplifying or qualifying the statements in the text. For example, the inference (p. 21) that "*plants and animals are built up of a number of indivisible unit factors upon which their characters depend*" (author's italics) surely requires a qualifying note to the effect that such unit factors may equally possibly be superposed on a basis which is different in nature.

The figures and diagrams are mostly clear and good, and there are well-reproduced portraits of Profs. Bateson and Punnett, in addition to a frontispiece of Gregor Mendel. The representation of a wrinkled seed in Fig. 5 is misleading, and the figure on the last page, illustrating the union of germ-cells, besides being rather obscure without further explanation, contains an inaccuracy in reproduction which might be confusing. Other small points which could be improved are the explanation of the 3 : 1 ratio, and the use of the symbols Fj, Fij, instead of the conventional F1, F2. We have perhaps unduly emphasised the small defects in what should prove an excellent introduction to the subject for those who read of it for the first time. L. D.

The Application of Logic. By Alfred Sidgwick. Pp. ix+321. (London: Macmillan and Co., Ltd., 1910.) 5*s*. net.

"THROUGHOUT this book 'formal' logic is identified not only with the logic which expressly calls itself formal, or 'deductive,' but with any logic which, like the ordinary 'inductive' logic, is, in fact, more formal than it professes to be. Wherever actual application and its difficulties are ignored, there is formality of a harmful kind."

Accordingly, Mr. Sidgwick discusses such matters as the ground of an inference, causal inquiries, ambiguity, indefiniteness, error, begging the question, distinction and definition, and the like, making constant use of well-chosen illustrative cases, and writing always in attractive and lucid style. There is some good protestation against slovenly modern usage of words. Why should "transpire" be allowed to mean "happen," "phenomenal" to mean "extraordinary"? We are much to blame in this; 'tis too much proved.

On general counts, Mr. Sidgwick views his subject from the point of view of Dr. F. C. S. Schiller.

Vergiftungen durch Pflanzen und Pflanzenstoffe: ein Grundriss der vegetalen Toxikologie für praktische Aerzte, Apotheker und Botaniker. By Dr. F. Kanngiesser. Pp. iv+49. (Jena: G. Fischer, 1910.) Price 1 mark.

THIS little work deals in a very concise form with the toxic nature and effects of various plants and plant-constituents; it is, in fact, a brief outline of vegetable toxicology.

In the first chapter the subject is dealt with from a general point of view, the symptoms that usually follow the ingestion of such poisonous or harmful substances being considered, as well as the means that may be adopted as remedies. In the following chapters a short account of the more important toxic plants and plant-constituents is given, accompanied in each case with the most striking symptoms it produces.

The author has certainly succeeded in compressing a large amount of information into a very small compass, and has produced a work that will be useful to physician and pharmacist, especially to such as reside in the country, where the accidental poisoning of children by eating toxic fruits and roots is unfortunately no rare occurrence. The book is remarkably free from error, but *Lobelia inflata, Tamus communis, Delphinium Staphisagria, Gratiola officinalis*, and some others might well have been included in the list of toxic plants, while Dr. Mitlacher's very useful work on toxic plants and vegetable drugs might have found a place in the bibliography.

HENRY G. GREENISH.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Colliery Warnings.

DURING the past thirty years, the Colliery Warnings appearing from time to time in various leading newspapers in the British coalfields have been vigorously, even viciously, attacked by a few mining engineers and professors of mining. Two excuses have been advanced as an explanation of these onslaughts—warnings are held to be an insult to the intelligence of miners, and, although based upon recorded facts, they are diametrically opposed to theory, to the common view, and to educated opinion. It is the *theory* that forms the burden of a column article on the subject in the *Times* of January 4, and it is the *theory* which Prof. Henry Louis harps upon in NATURE of January 12, pp. 336–8.

One of the most remarkable features of the various discussions has been the refusal of the theorists to accept any facts unless these can be made, somehow or other, to support the common view. Of Darwin it has been said that "he would destroy his theory rather than ignore a fact." It is a pity that many prefer to adopt the opposite principle, and are ever ready to dismiss facts which do not support popular beliefs. When definite facts are stated showing that the Colliery Warnings are issued during the periods when nearly all our mining disasters occur, the usual retort is that the cases have little or no bearing on the matter, and yet if a misstatement is made as to the atmospheric conditions, the theorists claim that the accident is one that supports their view. Newspapers are a fruitful source of error, especially in scientific matters. The melancholy fact is that, with all the "education" of the past forty years, people appear to be more ready than ever before to swallow the most ridiculous statements appearing in the Press under the guise of scientific information.

Here is Prof. Louis entering upon a crusade against Colliery Warnings because they are not in accordance with his theory. Of course, the first impression the general reader entertains is that the professor has mastered the meteorology of the subject, but when, as a witness before the Royal Commission on Mines, on May 27, 1908, he was asked if he was acquainted with the official daily meteorological reports, his reply was: "I have seen them, but I am not familiar with them," an admission which puts him out of court. Books of newspaper cuttings, on the other hand, are far more entertaining than dry official reports, and it does not require much research to alight upon definite statements that colliery explosions have occurred under a low or rapidly falling barometer. The most glaring of them is connected with the greatest mining disaster the world has ever known—the explosion in the Courrières mine, within a few minutes of 7 a.m. on March 10, 1906, when about 1200 miners perished. Prof. Louis, doubtless, read the statement in the *Colliery Guardian*, the organ of the mining engineers, that that frightful calamity was accompanied by a "pronounced fall of the barometer." The assertion fitted in exactly with the theory, and therefore there could be no possible objection to it. The statement, however, was most inaccurate. At the very moment that the pit blew up, observations were being taken all over France and neighbouring countries, and almost before it was known that the disaster had occurred, the *Bulletin International du Bureau Central Météorologique de France* had been prepared showing the existence of a well-marked area of high pressure right over France; the barometer had been rising throughout the previous night, it was rising at the time of observation, and subsequent reports showed that it continued to rise for some time after the explosion. No amount of juggling with what was said in the papers can get over the cold, dry record of facts. The official information is public property, which Prof. Louis and all who support him can consult at leisure and at trifling cost.

In May and June, 1910, readers of the *Scotsman* were treated to a discussion of the subject, one of the critics giving the worst case in his long experience of such an issue of damp in a mine in the east of Scotland "that the airways, &c., became so foul, the miners had perforce to leave off work and clear out." This dangerous outburst was said to be associated with the glass falling an inch in the course of a few hours. It agreed precisely with the popular notion of the external fitness of things. In a subsequent communication the critic, to dispel the doubt about the barometer having dropped at an unheard-of rate, supplied readings said to have been obtained from the Kew and Glasgow records. Unfortunately for the theorists, the Glasgow values show that the decrease of pressure on each of the two occasions relied upon was exactly *an inch less* than was stated by the critic, the barometer standing very high, in the first case perfectly steady, changing only 0·005 inch (not 1·005 inches) in six hours, and in the second case declining 0·112 inch (not 1·112 inches) in six hours. These imaginary falls of more than an inch in six hours will have got into many a scrap-book for future reference.

How determined the theorists are not to attach any weight to evidence which is unfavourable to them is well illustrated by the rash condemnation of the Seaham records by a leading supporter of the low-barometer idea:—"As to Mr. Corbett's figures, they have given us much amusement, as he got results flatly contradicting simple scientific principles. The Germans at Saarbrücken similarly." Facts obtained by careful observers in different countries are thus not entitled to consideration; they only deserve to be laughed at because they are at variance with preconceived notions.

Prof. Louis and his supporters are afraid that if they give way on this question, a terrible fate awaits the world—nothing short of casting Boyle's law to the scrap-heap. But they can rest assured that no such dire calamity is indicated. Boyle's law will for ever remain unassailable; what must go by the board and to the scrap-heap is the method adopted by the low-pressure theorists to support their views. Who first started the curious idea that the barometer falls at the rate of 0·01 *inch per minute* is not known, but it is the rate used by many writers here and abroad. It was adopted by the Royal Commission of 1879–86, by Sir Frederick Abel, by the *Colliery Guardian*, and others, to show that an acre goaf charged with a yard in depth of gas would foul a ventilating current of 1000 cubic feet per minute to the extent of 4·4 per cent., and the current is consequently nearing the explosive point, which is from 5 per cent. to 7 per cent. of fouling. There are two very serious objections to this conclusion. In how many mines in the United Kingdom do the Government inspectors consider 1000 cubic feet of air per acre of gas as ample for ventilating purposes? Has anyone ever known, within the temperate zone, falls of the barometer at the rate of 0·6 inch per hour, or 14·4 inches per day? The alleged fall of an inch in six hours at Glasgow, referred to above, is a mere nothing compared with the stupendous rate beloved of mining engineers. Continental experts who have studied the subject have decided that 0·04 inch (1 millimetre) per *hour* is a very rapid fall. A rate of 0·06 inch per hour is far from being a common occurrence, and intervals of years may pass between falls of so much as 0·1 inch in an hour. To prove their case, the theorists have adopted a rate which is fifteen times greater than a very rapid fall. Even if we apply 0·06 inch per hour, or 0·001 inch per minute, and keep to the 1000-foot ventilating current, it reduces the fouling from 4·4 per cent. to 0·44 per cent., a proportion which the firemen would have very great difficulty in detecting. There is here no violation of Boyle's law, which teaches us that the expansion of the gas is proportional to the diminution of pressure, not ten or fifteen times greater. In general terms, it may be stated that with a normal ventilating current no diminution of pressure in our latitudes is sufficiently great to bring out from the open goaf a volume of gas large enough to foul the ventilation to the explosive point.

Now as to the high-pressure side of the question. Prof. Louis strongly objects to Warnings against danger during anticyclonic periods, for they upset his teaching; but the note in NATURE of December 29 last, p. 277, shows that

there is a preponderance of explosions about the time that the central areas of anticyclones lie over our own coal-fields. Until Prof. Louis can prove that this statement, made by an independent investigator, is wrong, those who study the question with an open mind will not readily acquiesce in his theory, which requires the presence of a cyclonic area to bring about a disaster. True, Mr. Dobson's report to the British Association, and the papers to the Royal and the Meteorological Societies by Messrs. Scott and Galloway, were based on the theory that a low and falling barometer was necessary; but a glance at their diagrams is sufficient to show that accidents under a high barometer were attributed to a falling barometer at some other time, Mr. Dobson going so far away as a fortnight from an explosion to get a barometric fall to satisfy the theory. But when Messrs. Scott and Galloway had completed their inquiry from the purely theoretical side, the diagrams were ready, and the percentages of accidents under different conditions had been worked out, recourse was had to the very simple device of looking up the facts. Mr. Galloway was permitted to examine a large number of report books kept at mines in Scotland in 1873. To the amazement of the authors, they "found that sometimes a sudden fall of atmospheric pressure has taken place without causing gas to appear, and sometimes gas has suddenly appeared in considerable quantity when the pressure was high and steady." Before the Royal Commission of 1879–86, an experienced mining engineer, Mr. F. Wardell, stated that from his own observation explosions occurred generally on a rising barometer; and Mr. (now Sir) Henry Hall, the well-known Inspector of Mines, declared:—"More of the large accidents that have happened in my hands have happened when the glass was high, than otherwise." Evidence in support of these statements could be multiplied to any extent, and those who are interested in the question, instead of treating the evidence as merely amusing, should seriously endeavour to arrive at a reasonable explanation of the appearance of dangerous volumes of gas in mines when the barometer is rising or stands high.

There was a time when no one guessed that the earth's crust was always on the move, wobbling like a jelly; but Darwin started a new idea, declaring that the time would come when scientific men would no more regard the earth as immovable for any length of time than they would believe in an everlasting calm in the atmosphere. Since that declaration we have advanced a long way on the road towards proving the earth's crust, no longer supposed to be a rigid mass, liable to rise and fall under the vast changes of atmospheric weight indicated by barometric variations. To miners it has been a matter of common observation that earth movements are of frequent occurrence, and the evidence before the Royal Commission of 1879 showed that strong rock-roofs are either actually forced down or become much curved, eventually recovering their normal position when the gas-pressure is diverted in some other direction. The great disaster at Abercarne on September 11, 1878, when 268 lives were lost, had been preceded by outbreaks of gas daily from September 5 to 10, consequent upon a squeeze or settling down. Since the beginning of the month high barometric pressure had ruled—30·25 inches at Abercarne on the day of the disaster.

The Seaham records demonstrate clearly that there is an intimate relationship between the movements of the barometer and the pressure of the gas existing in sealed-up places in the earth—not the gas in the open goaf, which is acted upon directly by the air-pressure. The gauge inserted in the sealed-up reservoir of the Hutton seam showed that on every occasion when the barometer rose, even as on March 24, 1881, when it was at a very low level, the imprisoned gas showed an out-bye pressure, indicating that it was being compressed (Fig. 1). When the barometer was at its lowest, the compression ceased, and the gauge indicated an in-bye pressure. Those who discussed the observations were mystified; they could not get over the facts disclosed, and the only escape from the dilemma was by deciding that it was all the fault of the barometer—that it was not sensitive enough to fall twenty, thirty, or forty-eight *hours* sooner than it does! No physicist who has studied the action of the instrument would admit that, even supposing there is any lag, it would amount to as many *seconds*. It is a more reasonable suggestion that the increase of barometric pressure weighs down the earth's crust, and this, acting upon the imprisoned gas, increases its pressure. It is under these high-pressure conditions that Colliery Warnings have been issued through three decades, and it is under these same conditions that the worst explosions take place, for they are associated with great outbursts of gas flooding the workings suddenly, and not with the almost inappreciable, regulated flow of gas from the open goaf under a low and falling barometer.

THE AUTHOR OF THE WARNINGS.

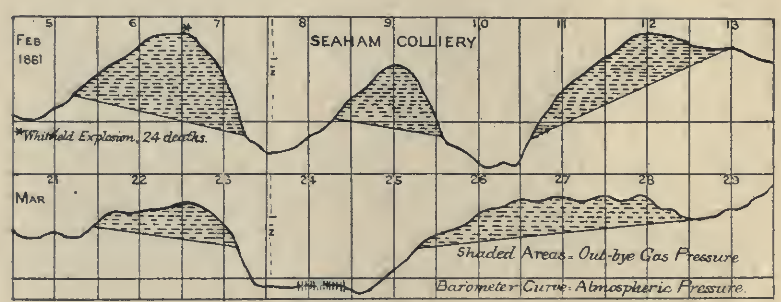


FIG. 1.

I AM delighted to find that my article on this subject has drawn a reply from the Author of the Warnings, though I must admit to disappointment at the character of his letter. In my article I stated certain facts as to the occurrence of firedamp in collieries, and showed how this gas must behave under varying barometric pressure in accordance with well-known physical laws; to my mind, there is only one proper way of controverting conclusions thus arrived at, and that is to show where I am mistaken in my statement of facts, in my enumeration of the natural laws, or in my deductions from these premises. This, however, is precisely what the Author of the Warnings has not even attempted to do; he has preferred to be guided by the old solicitor's maxim: "When you have no case, abuse the plaintiff's attorney."

I do not propose to follow the Author of the Warnings in the personal tone that he has introduced into the discussion, except to say that the theory—if theory it be—that a falling barometer is apt to correspond with an increase in the percentage of firedamp in the air of collieries is certainly not my theory, and originated long before my time. As the Author of the Warnings implies that these views necessarily connect colliery explosions with a low barometer, it seems worth while repeating that this is not my opinion; all that I maintain is:—

(1) Barometric variations are only a contributory cause, and a relatively unimportant one, of colliery explosions.

(2) A falling barometer, or, to be more precise, a flattening downwards of the barometric gradient, is apt to be accompanied by an increase in the percentage of firedamp in the air of mines.

Thus W. Köhler has shown that a slow increase in the percentage of firedamp may be due to a steady high barometer, or even to a slow rise following upon a very rapid one, *i.e.* to a flattening of the barometric gradient.

The Author of the Warnings appears to attach much importance to the Seaham Colliery records. Seeing how fiercely he has accused everyone else of only using such facts as suit them, it might be expected that he, at any rate, would be above reproach in this respect; unfortunately, however, it would be difficult to find a worse offender than he is in the use he has made of these records. In the first place, he ought to have made it clear that these records do not show gas pressure in a

mine under normal conditions; they were taken in a sealed-off portion of Seaham Colliery after an explosion and an underground fire, and thus represent what took place under an entirely abnormal condition of the mine. Apart from this point, the Author of the Warnings contrives to give his reader the impression that Mr. Corbett's Seaham Colliery records entirely favour his own views, that high barometric pressure causes an increase in firedamp in mines; so far from this being the case, however, Mr. Corbett's own words (Trans. North Eng. Inst. Min. Eng., vol. xxxii., 1882–3, p. 310) are:—"It is well known that gas is frequently found in colliery workings before any fall of the barometer commences. . . . The barometer, so far as an indication showing that gas may be expected, cannot be said to be reliable." In the discussion of this paper, Mr. J. Daglish (*ibid.*, p. 311) said that he had made experiments at Hetton Colliery, and that "the results he arrived at were precisely such as were given by Mr. Corbett, namely, that there was no connection whatever between the variations of the barometer and the prevalence of gas in the galleries of the mine." The chief witness cited in his favour by the Author of the Warnings is thus seen to give evidence quite directly against him when he is quoted correctly. Further, if the Author of the Warnings attaches the importance that he appears to do to these records of pressure, why does he not quote the very well known and much more applicable experiments of Sir Lindsay Wood, who determined the pressure of firedamp in normal coal seams by boring holes into them and inserting pressure gauges? His general conclusions (Trans. North Eng. Inst. Min. Eng., vol. xxx., 1880–1, p. 224) are:—"There is no connection between the variations of the barometrical column and the temperature with the quantities of gas evolved"; only in one set of tests, namely, at Eppleton Colliery, was any connection traceable, and, respecting these, Sir Lindsay Wood (*ibid.*, p. 182) states:—"With the barometer steadily rising, the gas pressure (with one or two exceptions, when there was an increase) steadily decreased."

Personally, I attach relatively little importance to records of pressure alone, even to such careful ones as those of Sir Lindsay Wood, Nasse, Broockmann, &c.; in the absence of analyses, it is only a conjecture that the pressure was caused by firedamp, and in the case of Seaham Colliery it is quite likely that other gases were present in large quantity. I hold that there is only one correct method of attacking this question, as has already been pointed out by Oberbergrat G. Köhler, and that is by systematic chemical analyses of the return mine air combined with barometric observations, as has been done on several occasions on the Continent, *e.g.* by Hilt at the Gemeinschaft and Alt-Gourley pits at Aachen, and, above all, by W. Köhler at the Grand Duke Frederick pits at Karwin. All the observations corroborated each other, and agree with the summary of W. Köhler:—"The proportion of firedamp in the air of the mine decreases in general with rising atmospheric pressure, and increases with falling atmospheric pressure. The proportion of firedamp increases the more rapidly the more steeply the curve of atmospheric pressure descends, and decreases the faster the more steeply the curve of atmospheric pressure rises." Harzé in Belgium and Behrens in Westphalia have confirmed these conclusions in their elaborate works on the subject. All this is the result of accurately observed facts, into none of which "theory" enters. All workers and observers in this subject have come to one of two conclusions, either that barometric variations have no decisive influence on the evolution of gas, or else that a falling barometric gradient increases the outflow of gas. Not a single writer, so far as I know, shows that a rising barometer increases the evolution of firedamp. Whilst most English authorities hold the first view, the universally held opinion in Germany is summed up thus by the well-known Saxon authority, E. Treptow:—"Im besonderen ist es als erwiesen anzusehen, dass nach einem schnellen Fallen des Barometers stärkere Gasentwickelungen stattfinden. Es ist daher die fortlaufende Beobachtung der Barometerstände von grosser Wichtigkeit; tritt ein Barometersturz ein, so ist besondere Vorsicht geboten. Ein Barometerfall von 1 mm. in einer Stunde ist schon sehr bedeutend." (In particular, it may be looked upon as demonstrated that, after a rapid fall of the barometer, stronger evolutions of gas take place. The continual observation of the height of the barometer is therefore of great importance; if a drop of the barometer takes place, special caution must be observed. A fall of the barometer of 1 mm. per hour is already very serious.)

It is facts like the above-quoted analyses that alone can decide this question; it is quite useless to inquire whether the barometer was high or low at the time of any particular colliery explosion, because a serious colliery explosion can only be brought about by the fortuitous coincidence of a number of contributory conditions, only one of which (and in all probability a relatively unimportant one) can be ascribed to the state of the barometer. The Author of the Warnings implies that my views have been influenced by newspaper statements as to the height of the barometer at the time of the great Courrières disaster; but not only do I, as I have said, regard such evidence as useless, but, above all, I would not commit the crowning absurdity of quoting in a discussion on firedamp the Courrières explosion, which is perfectly well known to have been a coal-dust explosion in a non-fiery pit.

Perhaps the most interesting point in the letter of the Author of the Warnings is his explanation of the reason why high barometric pressure must increase the percentage of gas in a pit; he believes that the increased pressure of the air squeezes down the earth's crust, and squeezes the gas out of it. I presume that he wishes this explanation to be taken seriously; but surely he has overlooked the very obvious fact that any increase of pressure on the surface of the earth, tending to squeeze gas out, is counterbalanced by an exactly equal increase of pressure upon the face of the coal in the mine, tending to keep the gas in, and that no variation of atmospheric pressure can thus disturb the previously existing *régime*. Even if this were not so, and if the crust of the earth could respond to such pressures, they are too insignificant to have any practical effect. An enormous fluctuation of barometric pressure, such as a rise of 1 inch, would correspond to a pressure on the earth's crust of only 70 lb. per square foot, or a good deal less than that of an ordinary crowd of people standing on the ground; the very suggestion that such a trifling weight can have any effect through thousands, or even hundreds, of feet of strata is so absurd as to require no refutation, and least of all to the mining engineer who has had to timber underground workings, and who knows that the roof pressure in a mine must be gauged, not in pounds, but in tons on the square foot, and that 70 lb. more or less will make no practical difference whatever. That such a theory should be relied on in defence of the Colliery Warnings surely justifies their opposition by mining engineers, and forms an emphatic endorsement of the verdict of the last Royal Commission —which, by the way, was not composed of professors of mining or theorists—upon these Warnings as *misleading and serving no useful purpose.*

H. LOUIS.

The Afterglow of Electric Discharge in Nitrogen.

IN a paper published in the current number of the Physical Society's Proceedings, I showed that the yellow afterglow produced by the electric discharge in rarefied air is due to the oxidation of nitric oxide by ozone, both substances being formed in the discharge. In a second paper, in course of publication, it is shown that several other oxidisable gases or vapours inflame spontaneously when mixed with ozone at a low pressure, and burn with phosphorescent flames of low temperature.

An afterglow in nitrogen has been recorded by Mr. Perceval Lewis (*Phys. Zeit.*, v., p. 546, 1904) which is obtained only with condenser discharges. This glow is orange in colour, and possesses a visual spectrum of three bright bands in the green, yellow, and red regions, in contrast to the continuous spectrum of the glow which I have traced to nitric oxide and ozone.

I have recently experimented with Lewis's nitrogen glow, using the method, introduced by Dewar in 1888, of drawing a continuous current of the gas through the vacuum tube into another vessel on its way to the pump.

I succeeded at once in obtaining it, when the condensed discharge was used. This glow has many interesting properties, of which a preliminary publication seems desirable.

I believe it to be due to pure nitrogen. Lewis states that it cannot be obtained from atmospheric nitrogen, but this does not agree with my experience. I have used atmospheric nitrogen exclusively.

The glowing nitrogen is unaffected by silver gauze, which quenches the ozone glows. It is destroyed by mixing oxygen with it, but merely diluted by hydrogen or ordinary nitrogen. When acetylene is led in, a bright flame is produced at the point of confluence. This flame replaces the original glow. It has a spectrum consisting of the swan and cyanogen bands, along with others not identified. If the nitrogen glow is led over iodine a magnificent blue flame is produced, contrasting sharply with the original orange glow. With sulphur the original orange glow is quenched, but no other replaces it. The sulphur becomes hot, and a metallic-looking sublimate is formed along the tube.

The most remarkable phenomena, however, are with metallic vapours, which give line spectra when the glowing nitrogen is led over them. Sodium, potassium, thallium, mercury, zinc, cadmium, and magnesium have all yielded line spectra in this way.

Investigation is being pushed on as fast as possible, but the facts so far obtained seem to point to the production of a chemically active modification of nitrogen. It is suggested, provisionally, that the spectra are developed by the chemical union of this active nitrogen with the various metals and with iodine and acetylene. The orange glow obtained with nitrogen only would, on this view, be due to the transformation of the hypothetical active nitrogen into ordinary nitrogen. R. J. STRUTT.

Imperial College of Science and Technology,
January 30.

Singularities of Curves.

I HAVE not, at present, access to the books referred to by "T. J. I'A. B." in his letter of January 12; but he is altogether wrong in thinking that the singularity he mentions cannot be investigated by the methods explained in my "Geometry of Surfaces." An arbitrary line through the origin has sextactic contact thereat; but since the axis of x has 12-tactic contact at the origin, the latter cannot be an ordinary sextuple point, because no line through such a point can have a higher contact than septactic. The singularity is either a singular point of the sixth order or one of lower order with coincident branches passing through it, and it illustrates the necessity of drawing a distinction between ordinary multiple points and singular points. The trilinear equation of the curve can be obtained by eliminating t between $\beta=\alpha t^6$, $\alpha\gamma-\beta^2=\beta^2(t^3+t^4)$. The factor $\alpha\gamma-\beta^2$ suggests the existence of tacnodal or other branches of a similar character, and that the singularity might be transformed into a simpler one lying on a curve of lower degree than the sixteenth by using Cremona's transformation,

$$\frac{\alpha}{\alpha'\gamma'+\beta'^2}=\frac{\beta}{\beta'\gamma'}=\frac{\gamma}{\gamma'^2}$$

before applying the methods of chapter iv. of my book.

But it would have been foreign to the plan of my treatise to have introduced parametric methods when discussing singularities; moreover, the method of which the example is an illustration is only applicable to unicursal curves, whereas my own methods are independent of the deficiency. For example, the various singularities the point constituents of which are nine nodes could not be investigated by means of a unicursal curve without complicating the problem by introducing additional nodes isolated or in combination sufficient in number to reduce the deficiency to zero; and this might limit the generality of the investigation, for when the nodes exceed a certain number they are not arbitrarily situated, but lie on one or more dianodal curves. A. B. BASSET.

January 14.

MR. BASSET now admits that he has seen neither Zeuthen's two papers of 1876 nor Jordan's book of 1893, thus practically acknowledging the accuracy of my criticism—that the treatment of singular points in his "Geometry of Surfaces" is incomplete. With this admission from Mr. Basset the matter ends, so far as I am personally concerned.

But I must enter a protest against Mr. Basset's inference that the methods of Zeuthen and Jordan are only applicable to unicursal curves; since Mr. Basset has not read the work in question, his only reason for this statement is the fact that the example in my first letter happens to be a unicursal curve. This example was made up so as to provide a simple illustration of the general methods; but these methods hold good for curves of any deficiency.

It is absurd to suggest that parametric methods cannot be used for any algebraic curve; of course, the coordinates are expressed in the form of infinite series (convergent near a particular point of the curve) instead of terminated series. Mr. Basset's objection to using parametric methods would be quite justified if he had provided us with a satisfactory substitute; but he gives no *systematic* plan for resolving an assigned singularity, and this is the main object of the parametric method as used by earlier writers. T. J. I'A. B.

FRANCIS GALTON.

FEBRUARY 16, 1822—JANUARY 17, 1911.

THE death of Francis Galton marks, not only the removal of another link with the leaders of the great scientific movement of the nineteenth century—represented by Darwin, Kelvin, Huxley, Clerk-Maxwell, and Galton in this country—but something far more real to those who have been in touch with him up to the last, namely, the cessation of a source of inspiration and suggestion which did not flag even to the day of his death. The keynote to Francis Galton's influence over the science of the last fifty years lies in those words: suggestion and inspiration. He belonged to that small group of inquirers, who do not specialise, but by their wide sympathies and general knowledge demonstrate how science is a real unity, based on the application of a common logic and a common method to the observation and treatment of all phenomena. He broke down the barriers, which the specialist is too apt to erect round his particular field, and introduced novel processes and new ideas into many dark corners of our summary of natural phenomena.

The present writer remembers being asked some years ago to provide a list of Francis Galton's chief scientific achievements for use on a public occasion. It did not seem to him that a list of isolated contributions, such as the establishment of anthropometric laboratories, the introduction of the composite photograph, the transfusion experiments to test pangenesis, the meteorological charts and improved nomenclature, the practical realisation of the possibilities of finger-print identification, the demonstration of the hereditary transmission of the mental characters in man, the law of regression, the idea of stirps, or the foundation of the novel science of Eugenics, fully represented the nature of the man. What is the spirit of the contributions—large and small, almost two hundred in number—which Francis Galton made to the science of the last sixty years? [1] The unity of those contributions lay largely in the idea that exact quantitative methods could be applied, nay, rather must be applied, to many branches of science, which had been held beyond the field of either mathematical or physical treatment. In this manner his inspiration and suggestion tended to give physical and mathematical precision to a large number of outlying sciences, to meteorology, to anthropology, to genetics,

[1] His first contribution dates from 1849 and concerns a method of printing telegraphic messages at the receiving station.

and to sociology. In this idea itself there is nothing novel; many of the world's great minds have realised the same truth. What did Roger Bacon say towards the middle of the thirteenth century?

"He who knows not mathematics cannot know any other science, and what is more, cannot discover his own ignorance or find its proper remedies."

How was it echoed again, full two hundred years later, by Leonardo da Vinci?

"Nessuna humana investigatione si po dimandare vera scientia s'essa non passa per le mattematiche dimonstrationi." *Libro di pittura* i. 1.

We wait another century and hear Lord Bacon's aphorism:—

"The chief cause of failure in operation (especially after natures have been diligently investigated) is the ill-determination and measurement of the forces and actions of bodies. Now the forces and actions of bodies are circumscribed or measured by distances of space, or by moments of time, or by concentration of quantity, or by predominance of virtue; and unless these four things have been well and carefully weighed, we shall have sciences, fair perhaps in theory, but in practice inefficient. The four instances which are useful in this point of view I class under one head as *Mathematical Instances* and *Instances of Measurements*."

The words actually used by Lord Bacon for his third and fourth instances are "per unionem quanti aut per prædominantiam virtutis." They cover very fully the sociological, psychological, and genetic phenomena which Francis Galton kept so closely in view.

Another hundred years, and again a great thinker echoes the same idea:—

"Ich behaupte aber, dass in jeder besonderen Naturlehre nur so viel eigentliche Wissenschaft angetroffen werden könne, als darin Mathematik anzutreffen ist." Kant: *Metaphysische Anfangsgründe der Naturwissenschaft.* Sämmtliche Werke, Bd. iv., S., 360. Leipzig, 1867.

Lastly, coming down to our own age, the great contemporary of Galton, Lord Kelvin, wrote:—

"When you can measure what you are speaking about and express it in numbers, you know something about it, but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind."

Clearly, then, Francis Galton was far from originating the idea that exact quantitative methods are applicable far beyond the range of the physical sciences. Wherein lies then his significance for the science of to-day and, perhaps, more still for the science of the future? Not solely in the fact that he sketched in broad lines the manner in which quantitative methods could be applied to many branches of descriptive science, but that without being a professor or teacher of students, he succeeded in creating a school of enthusiastic disciples who, inspired by him, have carried his work and his suggestions into practice in craniometry, anthropology, sociology, genetics, and medicine. The elements in Galton's character and life which made this achievement possible for him are manifold. Heredity, tradition, education, economic independence, all played their parts, and not least among these stands hereditary temperament. No younger man who knew Francis Galton at all intimately failed to be influenced by his marvellous keenness, his wide but wise generosity of suggestion and practical help, and above all, his equable and lovable personality. His manifest pleasure and gratitude for the simplest little thing done for him; his complete respect for the time and duties of others, whether they were his friends or the servants of his own household, produced a reverence which worked its effect, not only on his immediate environment, but upon the men who carried his inspirations and suggestions into practical science.

The exact biological bearing of religious differentiation upon the creation of human types has, perhaps, never been fully studied. The doctrines of George Fox drew together many men and women of a kindred spirit, and the stringent regulations as to outside marriage led not only to a union of similar natures, but, we venture to think, almost created a biological type. Not only did the Society of Friends unite men religiously, but it produced special temperaments genetically. Even to this day it is strange how men whose families have ceased to be Quakers, yet find that their common sympathies and temperaments arise from Quaker descent. Galton owed the evenness of his temper, his placid acceptance of criticism, but his power of steady persistence in his own work and his own views, very largely to his Quaker ancestry, to the Galton and Barclay blood. The fact that Galton was never in controversy was, of course, partly due to the novelty of many of his methods and ideas; they were beyond his generation, which left them largely on one side. Even his work on the heredity of the mental and moral characters in man was looked upon as merely academic, and its real bearing on social habits is only now being realised and pressed home.

For one man who had read "Hereditary Genius" (1869), "Human Faculty" (1880), and "Natural Inheritance" (1889), there were ten who had studied "The Origin of Species" or "Man's Place in Nature." But the former were the natural sequel to the latter, and Galton realised at once not only, as Darwin and Huxley did, that the new doctrines applied to man, but also that they must eventually be preached as a guide to human conduct in social activities. Looked at from this aspect, his labour to make anthropometry in both its physical and psychical branches an exact science; his discovery that new types of analysis are wanted to replace mathematical function in biological and social studies, and lastly, his advocacy of Eugenics—the science of the right breeding and training of man—are seen to be successive steps in a continuous ascent. The positive conception that science exists to serve man, and that its highest function is not merely to supply his material wants, but to show him how to elevate himself by obedience to biological principles, was the crowning conception of his life. He lived to see the wide appreciation of his teaching in both Germany and America, and, to perhaps a lesser extent, in Great Britain. But he did not live to see the controversies which will inevitably arise, as the world in general more clearly realises that not all its customs, not all its beliefs, not all its supposed morality and charity, are consonant with scientific knowledge.

But if the fact that Galton was never in controversy had partly a basis in the historic evolution of ideas, it was also deeply rooted in his temperament, the temperament of one portion of his stock. He considered criticism, not as it affected the reputation of his own work, but as it affected his own estimate of the validity of his own work, and he adopted it or passed it by accordingly. Only once do I remember on a public occasion a slight severity in his usually gentle tone. A medical man of distinction, speaking obviously without any knowledge of the literature of the subject, had asserted that the supposition that the children of parents with certain mental and moral peculiarities would reproduce these features, arose from a totally false conception of what the laws of heredity are. The mental and moral aptitudes were for the speaker

outside the purview of hereditary investigation. Galton's reply was very simple: Much of what his critic had said "might have been appropriately urged forty years ago, before accurate measurement of the statistical effects of heredity had been commenced, but it was quite obsolete now."

That is the extreme limit to which Galton's Quaker temperament ever, in the presence of the present writer, allowed him to reply, and here it was a question of checking a vague assertion which swept away the best part of a man's life work unexamined. That this calmness of mental attitude was very largely innate and not due to environment, is well brought out by a quaint little biography of the first eight years of his life, written by his mother (Violetta Galton—half-sister of Charles Darwin's father) when he went to a boarding-school in 1830.[1] His after-tastes and temperament, his great good nature, his calm temper, his resourcefulness and courage,[2] are sufficiently indicated by a mother who was closely observant, but who could have no knowledge of the future distinction of her youngest child. A further fundamental factor of Galton's mental outfit was his extraordinary mechanical ingenuity. This may also have been a Darwin heritage, for it has been shown by other members of the stock. At the same time his paternal grandfather, Samuel John Galton, was not only a statistician, but a man of mechanical tastes and a friend of Boulton and Watt, and the same form of ability was markedly evidenced in another grandson, Sir Douglas Galton.

Francis Galton had the mechanical ingenuity which makes a great engineer or experimentalist; his suggestions were always of the simplest kind, and he used the simplest constructions and the simplest materials. Most of his friends will remember his delight in some almost primitive solution of a mechanical difficulty, that possibly they had themselves pondered over and brought to him in despair. Nothing worries the secretary of a scientific society or the editor of a journal more than the vagaries of an author who provides diagrams wholly unsuited to the page-size of their publications; Galton would be ready with a photographic method of modifying the linear scales in different ratios in two directions. Nothing is more trying at lecture or theatre than the tall person or hat; Galton had his "hyperscope"—a simple tube with two reflecting mirrors at 45° by which he saw over or round them, and he would use it in a crowd when he wished to see what was going on beyond it. Or he would carry a wooden brick in a parcel with a long string attached to it; slowly lowering it in a crowd, he would stand on his block of vantage, and raise it again by its string afterwards without attracting observation. Elsewhere it has been said that, if one wanted to put a saddle on a camel's back without chafing it, to manage the women of a treacherous African tribe, to measure a snail's shell, or to work a theodolite in the midst of London traffic, Galton would tell you how it might be done.

Beyond mechanical ingenuity[3] he had great wealth of illustration; what he could possibly represent to the eye, he would do, for he had a firm belief that graphic representation is more impressive than mere numbers. Within a fortnight almost of his death, seated outdoors in a shelter, he was discussing with the present writer as eagerly and keenly as he would have done twenty years ago, the best method of graphically representing and comparing typical racial crania.

Through the last years of life, apart from his eugenic work, he was very busy in trying to deduce quantitative measures of general likeness; evidences of this were given in his letters on portraiture to this *Journal*, and in his attempts to make a graduated scale of "blurrers," which like a photometric wedge would equalise divergence until differentiation of the two compared portraits became impossible. Photographs of members of the same family—"similar and similarly situated," as the mathematicians have it—"blurred" more readily than those of strangers in blood. These things amount, not to complete fulfilments, but to suggestions and inspirations. But Francis Galton realised among the earliest that a comparison of the individual organs and characters of local races needs supplementing by a comparison in some manner of two "index" numbers, which by their deviation shall measure the similarity or diversity of these races, each as a unit complex of many individual characters.

Judged from the modern specialist standard, Galton was, perhaps, not a "mathematician," but he had enough mathematics for most of the purposes of scientific observation, and he knew how to enlist mathematical aid when he required it. Few of those who have really studied his work or come in contact with his singularly clear and logical mind, would have wished his education other than it was. The training in observation provided by hospital clerking under a good clinical teacher, could never have been replaced with profit by years spent over symbolic analysis; the man who would patiently watch the workman in a foreign country plying his chisel or trowel in order to learn differentiation of method in craftsmanship, and then take a lesson himself in handling the tool in the native way, was a born observer, whose talents lay in other fields than the higher abstract analytic. Yet the essential feature of his work was, and his reputation with the future will largely depend on, his extension of analytical methods to the descriptive sciences. Without Gauss the work of Quetelet would have been impossible. Without Quetelet we should perhaps have missed Francis Galton, and from Galton and his school the new methods have spread, and are spreading into the most varied branches of science; in medicine both treatment and diagnosis will be influenced by them, in physiology and psychology their advantages are being admitted, in biology, anthropology, sociology and its latest offspring—eugenics—their importance has been fully recognised. And wherein does the validity of this new treatment consist? It lies very simply in this, that Galton following Quetelet recognised that causation expressible in terms of mathematical function was not the only, or even the chief category, under which men of science can work; that exact methods were applicable to that looser relation or association, which now passes by the name of correlation. To Galton is due the honour of having reached the first simple measure of this relationship, and in the earlier writings of his keen disciple Weldon, we find it called "Galton's Function," a name which had to be dropped as the conception became more general and its types differentiated and classified. It ceased to be possible to call after its discoverer a philosophical category wider than that of causation, and embracing causation as a subclass.

The history—at least, the formal history—of his discovery is very suggestive of the man and his method. He had been studying the size of organs in parents and their offspring, and he formed what is now termed a correlation table; that numerical table he sought to

[1] Would it be safe to suggest that Galton inherited from his Darwin mother his views on family history? Is "The Life History Album" (Macmillan, 1884 and 1903) with its spaces for observations and photographs of the child, a lineal descendant of this biography with silhouette illustration?

[2] This was of much value to him in his later travels. When five years old his mother took him into a field where the servants were trying to catch some geese. Francis immediately ran among them and seizing the old gander by the neck brought him to his mother muttering at the same time to himself the lines from "Chevy Chase":

"Thou art the most courageous knight,
That ever I did see —— ——"

[3] Many of the contrivances devised for his first Anthropometric Laboratory are still in current use.

represent graphically, and to his delight and surprise the rough contour lines, which he drew on the table itself, had the appearance of a family of similar and similarly situated ellipses. The line which joined the means of the organs of the offspring for a given organ in the parent was seen to be straight, and to be the locus of the points of contact of a system of parallel tangents to the ellipses. Galton had reached from his graph the fundamental idea of the simplest type of correlation surface—the generalised Gaussian with linear "regression," and he was not slow to realise its great importance and its wide application to the inter-relationship of contemporaneously varying or associated phenomena. He summoned mathematical aid, and with the help of Mr. Dickson determined the form of the Gaussian frequency surface. Years afterwards it was discovered that the mathematics of that surface had been worked out by Bravais, in considering the distribution of shots over a target. Nowadays we know that there are frequency surfaces which are not Gaussian. Wherein then does the transcendant importance of Galton's work lie? Why, in the fact that he was *not* considering shots at a target, but that he was seeking for a key to open a door for exact quantitative methods into the whole wide range of vital phenomena. From Bravais' mathematical treatment of the Gaussian surface nothing followed, until Galton independently rediscovered it with no idea of shots at a target in his mind, but with the idea of investigating problems in genetics, in evolution, and in sociology.

His work first pointed out to us how the whole field of nature lay open to exact numerical treatment, if we dropped the category of causation and adopted that of correlation.[1] Not from Bravais' mathematics, but from the suggestion and inspiration of Galton's contour lines on his table of observations, has sprung the whole body of modern statistical theory. The problem of evolution, and the study of heredity, were for Galton actuarial problems. Needless to say, he did not place on one side the study of individuals, he was ever in sympathy with individual observation and experiment. But, as the late Prof. Weldon expressed it in a sentence which had Galton's hearty assent, "the actuarial method must be an essential part of the equipment of any man who would make and understand such experiments." It was in this very sense that Galton initiated the Royal Society "Committee for conducting Statistical Inquiries into the Measurable Characteristics of Plants and Animals." And for a long time he had in mind the eventual foundation and endowment of an experimental station for variation, heredity, and selection, treated by statistical methods. If his gift to posterity be now found to have taken another form from his original idea, the change is not unassociated with his views on the need for adequate statistical treatment, or with the change of purpose and method which led to his withdrawal from the Evolution Committee.

If we turn from the inspiration and suggestion provided by Galton in many varied forms of inquiry to his actual contributions to our knowledge, two will occur to the minds of most readers, not necessarily because they are the most important, but because some statement of them has crept into elementary text-books and popular works on science. The first of these is the oft-quoted "Law of Regression"; it was not originally a theoretical deduction but deduced by Galton from his own measurements and observations on individuals. It amounts to the statement that if in a stable population—*i.e.* one in which no selection is taking place, and which is mating at random—a group of all the parents be selected which have a character of a given intensity, then the average of the same character in their offspring will be nearer to the mean of the whole population than the parental value. As Galton stated this statistical result, it has been over and over again verified by mass-investigations. But it has been singularly often misinterpreted by commentators. One group of them extended it into a general law that all populations tend to regress to mediocrity, if we suspend natural selection; they quite overlooked Galton's statement that the population was *stable*. No such general regression to mediocrity was involved in Galton's law of regression; it was a statistical law of distribution of offspring resulting from the *stability* of the population. Another group of critics selected certain special parents, overlooking Galton's word "all," and endeavoured to show that the law did not apply to their offspring, and must therefore be erroneous. The fact is that the very law itself, when applied to the offspring of somatically selected ancestry and not to all parents of the class, shows the cessation of regression, and it is upon this very cessation of regression for selected sub-classes that the general stability of the Galtonian population depends.

The second contribution to the theory of heredity with which Galton's name has been generally associated is that termed the "Ancestral Law of Heredity." The conception Galton had in mind was the following one: in a population mating at random and stable in character, what would be the *average* relation of each class of individuals in the new generation to each grade of their ancestry? Naturally, he measured the relation by his new method of correlation, practically by aid of the steepness of his regression lines. The degree of resemblance to successive grades of the ancestry was found to diminish in a geometrical progression. The exact numbers reached by Galton from his data ($\frac{1}{3}$, $\frac{1}{9}$, $\frac{1}{27}$, &c.) have not been verified by further observation. But the fundamental features of his method, the idea of applying multiple regression and the diminution of the degree of resemblance in a geometric series, have been found correct. Indeed, we now realise that almost any determinantal theory—including that of Mendel—leads directly to Galton's Law of Ancestral Heredity as stated above. No direct test of adequate[1] character has yet been made on Galton's Law, as it is commonly cited—a form which he originally stated himself with great hesitation ("Natural Inheritance," p. 136), and which does not appear wholly in accord with other parts of his observational or theoretical treatment. Strange as it may seem, no one has yet worked out the relationship corresponding to the usually stated form of Galton's Law for a simple Mendelian population breeding at random; the theoretical investigation of it is beset with many analytical difficulties and not a few logical pitfalls. All the criticisms of this law have turned on results deduced from selected gametic ancestors.

It has been asserted with some plausibility that Galton's deductions would cease to be of any value

[1] "The conclusions . . . . depend on ideas that must first be well comprehended, and which are now novel to the large majority of readers and unfamiliar to all. But those who care to brace themselves for a sustained effort, need not feel much regret that the road to be travelled over is indirect and does not admit of being mapped beforehand in a way they can clearly understand. It is full of interest of its own. It familiarizes us with the measurement of variability and with curious laws of chance that apply to a vast diversity of social subjects. This part of the inquiry may be said to run along a road on a high level, that affords wide views in unexpected directions, and from which easy descents may be made to totally different goals to those we have now to reach. I have a great subject to write upon, but I feel keenly my literary incapacity to make it easily intelligible without sacrificing accuracy and thoroughness."—(Francis Galton, "Natural Inheritance," 1889, p. 2). It is those "easy descents" to "totally different goals" which have proved very arduous, not because they were not obvious and easy so soon as the "high level road" had been made, but because they turned out to lead into strictly preserved but largely untilled "strays."

[1] Certain investigations have been made, but in every case they will be found not to fulfil the conditions as to average relations, which Galton laid down. Galton's own material for "Basset Hounds" is really inadmissible, for there is scarcely any doubt about the fictitious character of many of the putative sires.

if we could discover the physiological causes of heredity. To this, we think, answer may be made that Nature does not work like the breeder by testing gametic qualities. She proceeds by selecting with stringency certain grades of somatic qualities, and the intensity of quality, not the gametic value of the individual is her index to survival. Without some degree of correlation between somatic character and gametic value, the Darwinian theory must collapse. This point Francis Galton had ever in mind, and his views on heredity, and his treatment of the subject, always turned on the effect of somatic selection of the ancestry in modifying the somatic characters of the offspring. Hence the establishment of a definite theory of physiological heredity would at once have to be followed by a theoretical deduction from that theory of the degree of resemblance between somatic characters in ancestry and offspring in a population living under natural conditions. The questions of fertility and death-rate in such a population are actuarial studies. No physiological inquiry as to heredity can supersede those studies, but such an inquiry may well confirm, or it may modify, the laws originally stated by Francis Galton for populations mating at random. So far as it is possible to judge at present, current physiological theories of heredity tend rather to confirm than refute Galton's conclusions.

Of the work of the last decade of Galton's life, it is possibly too early yet to speak with any decisive judgment. Darwin, writing to Wallace in 1857, uses the following words:—

"You ask me whether I shall discuss 'man.' I think I shall avoid the subject as so surrounded with prejudices, though I fully admit it is the highest and most interesting problem for the naturalist."

Darwin's later writings testify that he did not avoid the subject, but probably the existence of the prejudices to which he refers prevented him from accentuating the direct practical bearing of the doctrine of evolution on human conduct. The result of this attitude of the earlier evolutionists was that their strength was opposed to one wing only of the army of intellectual inertia. Their critics were theologians and metaphysicians; there was no question raised of the bearing of evolution on social habit. Evolution appeared merely as a problem of a man's intellectual attitude towards the universe, it was a philosophical belief, not a practical code of conduct. Francis Galton's Huxley lecture of 1901 "On the possible Improvement of the Human Breed under existing conditions of Law and Sentiment," slender as it seemed at the time, was really the clarion call which told us that the time was ripe for the recognition that the doctrines of evolution and heredity were more than intellectual belief, they were destined to control the conduct of men in the future and determine the relative efficiency of nations. Others may have thought, some may have said, the same thing before;[1] but to Francis Galton belongs the credit of having said it at the psychological moment, and said it with the emphasis that made many earnest men and women understand its gravity. Later, in his paper of 1904, "Eugenics: its Definitions, Scope, and Aims," Galton more closely defined the lines of development he had in view for the new science:—

"Persistence in setting forth the national importance of eugenics. There are three stages to be passed through: *firstly*, it must be made familiar as an academic question, until its exact importance has been understood and accepted as a fact; *secondly*, it must be recognised as a subject the practical development of which deserves serious consideration; and *thirdly*, it must be introduced into the national conscience, like a new religion. It has, indeed, strong claims to become an orthodox religious tenet of the future, for eugenics cooperate with the workings of Nature by securing that humanity shall be represented by the fittest races. What Nature does blindly, slowly, and ruthlessly, man may do providently, quickly and kindly. As it lies within his power, so it becomes his duty to work in that direction; just as it is his duty to succour neighbours who suffer misfortune. The improvement of our stock seems to me one of the highest objects that we can reasonably attempt. We are ignorant of the ultimate destinies of humanity, but feel perfectly sure that it is as noble a work to raise its level in the sense already explained, as it would be disgraceful to abase it. I see no impossibility in eugenics becoming a religious dogma among mankind, but its details must first be worked out sedulously in the study. Over zeal leading to hasty action would do harm, by holding out expectations of a near golden age, which will certainly be falsified and cause the science to be discredited. The first and main point is to secure the general intellectual acceptance of eugenics as a hopeful and most important study. Then let its principles work into the heart of the nation, who will gradually give practical effect to them in ways that we may not wholly foresee."

We have cited the whole paragraph, for it is essentially typical of the man, and some word of his message to his nation may fitly appear here. Conspicuously moderate in tone, the study at each point placed before the market-place, it was, indeed, a wonderful appeal for a man more than eighty-two years of age to make from the public platform. It signified that the time was ripe for the labours of the biologist to be turned to the breeding of man. Galton called upon the biologist, the medical man, and the sociologist to grasp what evolution and heredity mean for man, to make out of their science an art, and work thereby for the future of their nation. Nor has that appeal miscarried; its effect may be traced even amid the din of controversy and clash of diverse opinions in almost every recent book, or discussion of heredity or evolution. Those of us, who initially doubted the wisdom of propagandism beyond the academic field, have lived to see a very wide public impression made, not only in this country, but notably in Germany, America, and some of our colonies. If that movement remains within the lines Galton assigned to it—"no over-zeal leading to hasty action" which will "cause the science to be discredited"—then we firmly believe that to the future Galton's life will appear as a rounded whole—the youth of experience and observation, the manhood of development and discovery of method, the old age of practical application.

His school and disciples have lost a leader, but not before he had lived to put the final touches to his work. Of his generosity and helpfulness, his personal modesty and simplicity of nature, many of those who came in touch with him can bear evidence by remembered talk, by letter, and by act. Someday, perhaps, these things may be put together as a memento of

[1] For example, Sir W. Lawrence wrote in 1819:—"The hereditary transmission of physical and moral qualities, so well understood and familiarly acted on in the domestic animals, is equally true of man. A superior breed of human beings could only be produced by selections and exclusions similiar to those so successfully employed in breeding our more valuable animals. Yet, in the human species, where the object is of such consequence, the principle is almost entirely overlooked. Hence all the native deformities of mind and body, which spring up so plentifully in our artificial mode of life, are handed down to posterity and tend by their multiplication and extension to degrade the race. Consequently the mass of the population in our large cities will not bear a comparison with that of savage nations, in which, if imperfect or deformed individuals should survive the hardships of their first rearing, they are prevented by the kind of aversion they inspire from propagating their deformities" What finer text for the eugenist? But Lawrence spoke to a nation still flushed with Waterloo, while Galton, eighty-five years later, appealed to its grandchildren still smarting from South African defeats, and dimly conscious that all was not well with either its physical or mental vigour.

the man whose teaching has just ended, but whose life-work has only begun to run its course. Rewards came to Francis Galton—medals, honorary degrees, corresponding memberships of many learned societies—they came unsought, but not unappreciated. His very modesty made him take an almost childlike joy in these recognitions of his worth, and the present writer remembers with what pleasure, but a few weeks ago, Galton showed him his recently received Copley medal. But these things were not of the essence of his life. Few men have worked so little for reputation and so much for the mere joy of discovering the truth. His three chief pleasures in life were first to discover a problem, secondly to solve it by a simple but adequate process, and thirdly to tell a congenial friend of the problem and its solution. What he cared chiefly for was the sympathy of men who appreciated his special type of work and understood its relation to human progress. Had he spoken of himself and his feelings, which he rarely did, he would, we think, have described his purpose in life much in the words of Huxley:—

"To promote the increase of natural knowledge, and to further the application of scientific methods of investigation to all the problems of life to the best of my ability, in the conviction which has grown with my growth and strengthened with my strength, that there is no alleviation for the sufferings of mankind except veracity of thought and action, and the resolute facing of the world as it is when the garment of make-belief, by which pious hands have hidden its uglier features, is stripped off."

But in the fulfilment of his purpose Francis Galton was an optimist. He believed that man can not only physically control his environment, but with fuller biological knowledge his future development. Not on this or that contribution to the records of science, but on the justification of this belief, will depend his fame in the roll of the ages. There are some of us who believe that among the great names cited at the commencement of this paper, Galton's will not be the last, for he has given an inspiration which will grow to full fruition. Our country has been the land of dominant scientific ideas rather than of massive contributions to the records of science—gravitation, the survival of the fitter, the electromagnetic theory—may we yet add—the biological control of human development? If so, the name of Francis Galton will be closely associated with the coping-stone of the edifice, which had its foundations first securely laid by his half-cousin, Charles Darwin.

MEGALITHIC MONUMENTS AND PREHISTORIC CULTURE IN THE WESTERN MEDITERRANEAN.[1]

AMONG the many questions to which the attention of the British School at Rome is now directed none is of more interest and importance than the exploration of the megalithic remains and primitive culture of the western Mediterranean which is now in progress.

Sardinia, much the most promising field of study, is in the hands of Dr. Mackenzie, the value of whose report is greatly increased by the admirable plans prepared by Mr. F. G. Newton. First among these remains come the Nuraghe or fortified towers, of which more than one type has been identified. The most primitive form is perhaps the simple strong tower of circular shape, to which succeeded the type represented by that of Voes, a massive triangular building, having four circular chambers on the ground floor and a central unroofed courtyard opening into a massively constructed corridor leading to smaller inner rooms. Above this was a second storey, now ruined, which may have formed the living part of the house and the abode of the women, while the lower floor was occupied partly by guards and attendants and partly used as storehouses. These forms soon develop into more complex types, until we reach an elaborately fortified enciente with massive corner towers, like that of Nossia. Dr. Mackenzie reasonably suggests that in the Bronze age the lords of these Nuraghe may have possessed only limited sovereignty, and that these elaborate fortifications were designed in the event of incursions by the neighbouring local chiefs.

The chief interest of the report lies in the fact that for the first time a seriation of the dolmens is attempted, and that these are now brought into relation with the Nuraghe. First comes the dolmen in its primitive form, familiar in western Europe—a massive slab resting on upright supports and forming a rude chamber. The next stage is illustrated by the monument at Maone, which, instead of being a mere cella with vertical supports, is partly hewn into the sloping rock, partly built up with rough coursed masonry, on the top of which rests the cover-slab. Then comes the form, represented by the dolmen of Su Covecco, which is on the point of being elongated and becoming a so-called "Giants' Tomb." In the latter the apse-like arrangement persists, but the cella and well of the enclosure are much extended, and exhibit a whole series of cover-slabs instead of the single massive stone in the primitive dolmen type. The structure thus often simulates the form of an inverted boat, like the Naveta tombs of the Balearic Islands, which gained their name from this fact. They were perhaps designed to symbolise the boat which conveyed the souls of the people, immigrants from beyond the sea, to a place of rest across the ocean. But the original dolmen type seems to have survived into this later period, and in one case the tomb is provided with a secret entrance, which may have been intended for subsequent interments, while the smaller portal hole in the front was reserved for the periodical rites in honour of the ancestral spirits.

Mr. Peet's report on the prehistoric period in Malta is mainly devoted to a criticism of the views of Albert Mayr, who regarded the culture of prehistoric Malta as mainly Ægean. Mr. Peet, dealing in succession with the arguments based on the use of overlapping or splayed masonry, the occurrence of the spiral form of ornament, and the baetylic or pillar worship, points out that none of these have special Ægean or Mycenæan provenience, and while not denying the existence of Ægean culture in Malta, he regards it impossible to attribute all that appears in the island to this source.

It may be hoped that the establishment of a new society for the promotion of Roman studies will give a fresh impetus and supply increased resources for the survey which has been so well started by Dr. Mackenzie and Mr. Peet.

[1] "Papers of the British School at Rome." Vol. v. Pp. xiv+471+47 plates. (London: Macmillan and Co., Ltd., 1910.) Price 42s. net.

THE FLIGHT OF BIRDS.

TO *La Nature* for December 11, 1910, M. Lucien Fournier contributes a well illustrated article on the flight of birds. One of the pictures, showing various positions taken by the wings of gulls in flight, is here reproduced. Three other of the illustrations, namely

a flight of gulls, a stork leaving its nest, and a flying vulture, are particularly good.

The author separates birds into four groups, according to the characteristics of their flight, as follows:—(1) Wings always flapping; (2) flapping alternating with downward gliding; (3) Flapping and gliding with maintained level; (4) gliding and soaring only.

This classification can hardly be considered satisfactory. It is suggested that a bird can fly without any expenditure of work provided that there is even a slightly variable wind, and the article concludes with the hope that the day is not far distant when (by proper automatic devices to take advantage of wind variation) flying machines will be able to do without engines.

In reality no bird or flying machine can maintain its level or rise in still air or in a uniform horizontal wind without the expenditure of power, and although it is true that power may be gained from the air by a proper utilisation of the differences of the horizontal velocity in the different regions traversed, these differences would have to be large even for the sustenance of long-winged birds, and there is no direct evidence that this kind of flight is habitual with them.

It is not improbable, however, that with their long experience birds have found out its possibility, and the skimming of some birds near the surface of the waves, where the variations of velocity are great, may be a case in point, but there can be little doubt that when flying at a considerable height birds depend for their support on an upward component in the velocity of the wind.

A. MALLOCK.

A group of Gulls in flight, showing various positions of the wings of birds.

SCIENCE AND LITERATURE.

AN eloquent address on language and literature was delivered on January 27 by Lord Morley of Blackburn, as president of the English Association. Parts of the address dealt with the relation between science and letters, with particular reference to the use of scientific knowledge in poetry, and the antithesis between documentary fact and artistic style. Science aims at concise and truthful expression; and while Lord Morley testified to the value of its influence upon literature, he doubted whether scientific ideas had inspired even Tennyson to the best verse, whether the desire for fact scientifically recorded is not a misfortune in the treatment of modern history, and whether concentration upon scientific truth has not a deadening effect upon emotional conceptions and pleasures.

Lord Morley's tribute to some scientific masters of clear and simple exposition resigns us to his subsequent conclusions. Keats could not forgive optics for robbing the rainbow of its wonder and mystery, and Lord Morley seems to suggest that the literary art which deals with scientific studies and results is not of the highest. But poetry is imagery, and new images of Nature are made possible by every discovery of the attributes and meaning of the things around us. The poetry which neglects advances of natural knowledge becomes conventional in form and substance, concerning itself only with the wonders of childhood because it does not understand the higher and grander mysteries which science has failed to penetrate. His-

tory is concerned with the accumulation and consideration of facts with the view of arriving at correct conclusions from them; and in this respect it must be studied by the methods of science, though the human factor makes the problems more difficult than when material things only are involved. There is, however, no intrinsic reason why Gibbon's majesty of historic conceptions, and the symmetric grandeur of his design, should not be combined with such great learning as was displayed by Lord Acton. Accurate knowledge must surely not be considered as antithetic to perfection of style.

The instance of Darwin's loss of interest in poetry and music proves little. A wide search through the biographies of distinguished men of science will only reveal two or three cases in which devotion to studies of Nature has resulted in the atrophy of æsthetic faculties. Close concentration upon any particular subject often leads to indifference to the aims and work of others; but this is as true of art, or poetry, or music, as it is of science. There is less reason for believing that the man of science has usually no taste for literature, music, or other forms of refined and imaginative expression, than there is for concluding that artists, musicians, and poets have no interest in the attentive study of natural objects and phenomena. If science and documentary evidence are responsible for an age of prose, it is because the poets have been spinning cobwebs from their brains when they ought to have been learning something of the spirit and achievements of science. These are they who, having never entered upon scientific pursuits, are, to use Herbert Spencer's words, "blind to most of the poetry by which they are surrounded."

Subjoined are some extracts from Lord Morley's address—

Let me offer a few words on the effects of the relations of letters and science. We may obviously date a new time from 1859 when Darwin's "Origin of Species" appeared, and along with two or three other imposing works of that date launched into common currency a new vocabulary. We now apply in every sphere, high and low, trivial or momentous, talk about evolution, natural selection, environment, heredity, survival of the fittest, and all the rest. The most resolute and trenchant of Darwinians has warned us that new truths begin as rank heresies and end as superstitions; and if he were alive to see to-day all the effects of his victory on daily speech, perhaps he would not withdraw his words. That great controversy has died down, or at least takes new shape, leaving, after all is said, one of the master contributions to knowledge of nature and its laws and to man's view of life and the working of his destinies.

Scientific interest has now shifted into new areas of discovery, invention, and speculation. Still the spirit of the time remains the spirit of science, and fact and ordered knowledge. What has been the effect of knowledge upon form, on language, on literary art? It adds boundless gifts to human conveniences. Does it make an inspiring public for the master of either prose or verse? Darwin himself made no pretentions in authorship. He once said to Sir Charles Lyell that a naturalist's life would be a happy one if he had only to observe and never to write. Yet he is a writer of excellent form for simple and direct description, patient accumulation of persuasive arguments, and a noble and transparent candour in stating what makes against him, which, if not what is called style, is better for the reader than the finest style can be. One eminent literary critic of my acquaintance finds his little volume on earthworms a most fascinating book even as literature. Then, although the controversial exigencies of his day affected him with a relish for laying too lustily about him with his powerful flail, I know no more lucid, effective, and manful English than you will find in Huxley. What more delightful book of travel than the "Himalaya Journals" of the great naturalist Hooker, who carried on his botanical explorations some sixty years ago, and happily is still among us?

Buffon, as man of science, is now, I assume, little more than a shadow of a name, and probably even the most highly educated of us know little more about him than his famous pregnant saying that the style is the man—a saying, by the way, which really meant no more than that, while nature gave the material for narrative, it is man who gives the style. Yet the French to this day count him among the greatest of their writers for order, unity, precision, method, clearness in scientific exposition of animated nature, along with majestic gifts of natural eloquence. Then comes the greatest of all. Whatever the decision may be as to the value of Goethe's scientific contribution, this, at least, is certain, that his is the most wondrous, the unique case of a man who united high original scientific power of mind with transcendent gifts in flight, force, and beauty of poetic imagination.

As for science and the poets, only the other day an attractive little book published by Sir Norman Lockyer shows how Tennyson, the composer of verse unsurpassed for exquisite music in our English tongue, yet followed with unflagging interest the problems of evolution and all that hangs upon them. Whether astronomy or geology—terrible muses, as he well might call them—inspired the better elements of his beautiful work, we may doubt. An English critic has had the courage to say that there is an insoluble element of prose in Dante, and Tennyson has hardly shown that the scientific ideas of an age are soluble in musical words. Browning, his companion poet, nearly universal in his range, was too essentially dramatic, too independent of the scientific influences of his day, too careless of expression, to be a case much in point. Tennyson said of him, he had power of intellect enough for all of them, "but he has not the glory of words." Whether he had or not, science was not responsible.

I should like to name in passing the English poet who, in Lowell's words, has written less and pleased more than any other. Gray was an incessant and a serious student in learned tongues; and his annotations on the "Systems of Nature," by Linnæus, his contemporary, bear witness to his industry and minute observation as naturalist.

In prose fiction was one writer of commanding mind, saturated with the spirit of science. Who does not feel how George Eliot's creative and literary art was impaired, and at last worse than impaired, by her daily associations with science? Or would it be truer to say—I often thought it would—that the decline was due to her own ever-deepening sense of the pain of the world and the tragedy of sentient being?

Let us look at the invasion of another province by the spirit of the time. The eager curiosity of all these years about the facts of biology, chemistry, physics, and their laws has inevitably quickened the spread both of the same curiosity and the same respect, quickened by German example, for ascertained facts into the province of history. Is the pure scientific impulse—to tell the exact truth with all the necessary reservations—easy to combine with regard for artistic pleasure?

The English writer of our own immediate time, with the fullest knowledge and deepest understanding of the fact and spirit of history, would, I think, be pronounced by most critics with a right to judge to be the late Lord Acton. Acton's was a leading case where knowledge and profundity was not matched by form. His page is overloaded, he is often over-subtle, he has the fault—or shall I call it the literary crime?—of allusiveness and indirect reference—he is apt to put to his reader a riddle or a poser, and then to leave him in the lurch. Here is Acton's own account of the historian's direct debt to the methods of science:—"If men of science owe anything to us," he says, "we may learn much from them that is essential. For they can show how to test proof, how to secure fulness and soundness in induction, how to restrain and employ with safety hypothesis and analogy. It is they who hold the secret of the mysterious property of the mind by which error ministers to truth, and truth irrecoverably prevails."

Where the themes and issues are those of scientific truth, that prose should be unemotional is natural. Every-

body knows Darwin's own account, how, as the laborious years passed, he so lost his taste for poetry that he could not endure to read a word of it; Shakespeare became so dull it nauseated him, and music set him thinking too energetically on what he had been working at, instead of giving him pleasure. If all this loss was the price of years of fruitful concentration in the master, who can wonder if the scientific and documentary age is an age of prose?

NOTES.

We are delighted to learn that the sum of 25,000*l.* required for the purchase of the site for new chemical laboratories at University College, London, has now been obtained, thanks to a generous gift of 4500*l.* from Mr. Ralph C. Forster, The Grange, Sutton, Surrey. He is a member of the firm of Messrs. Bessler, Waechter, and Co., merchants, of Salisbury House, E.C. He was Sheriff for the county of Surrey in 1906. The total sum required for the purchase of the site and the erection of the laboratories was 70,000*l.* It is estimated that a sum of between 45,000*l.* and 50,000*l.* is still required for the erection of the buildings. It is hoped that this object will commend itself to the generosity of some public-spirited citizen, who will come forward with what is required to complete the scheme.

The Chemical Society of France has recently elected the following foreign honorary members:—A. v. Baeyer, Munich; Emil Fischer, Berlin; P. Guye, Geneva; L. Henry, Louvain, Belgium; C. Istrati, Bucharest; A. Lieben, Vienna; Louguinine, St. Petersburg; Raphael Meldola, London; Paternò, Rome; Sir Wm. Ramsay, London; and Ira Remsen, Baltimore. The late Prof. S. Cannizaro had also been nominated by the council, but his death prevented his nomination being confirmed by the general meeting of the society.

An international committee of representative men of science of distinguished eminence has been formed to raise the funds necessary to celebrate appropriately the jubilee of Prof. Gaston Darboux's connection with French university education, the distinguished work he has done for mathematics, and his services as permanent secretary of the Paris Academy of Sciences. Donations may be sent to Prof. Guichard, the general secretary of the international committee, at the Sorbonne, Paris. It is proposed to present Prof. Darboux with a medal, reproducing his portrait, together with an address signed by the subscribers. Subscriptions of 25 francs will give the right to a medal in bronze, and of 50 francs to a medal in silver, which will be reduced reproductions of that to be offered to Prof. Darboux.

The death is announced, in his seventy-first year, of M. E. A. Léveillé, formerly president of the French Entomological Society.

The president of the Bureau des longitudes in Paris for the present year is M. G. Bigourdan. M. B. Baillaud is the vice-president, and M. H. Andoyer the secretary.

On Wednesday next, February 8, a portrait of Prof. W. Boyd Dawkins, F.R.S., will be publicly presented to the University of Manchester by the subscribers. The presentation will take place in the Whitworth Hall of the University at 4 p.m.

At a meeting of the research department of the Royal Geographical Society on Thursday, February 16, Prof. Edgeworth David, C.M.G., F.R.S., who was geologist on Sir Ernest Shackleton's Antarctic expedition, will submit his views on certain important Antarctic problems, namely, climate, physical structure, tectonic relations with the Andes, &c.

Four lectures on plague will be delivered on February 14, 15, 16, and 17 by Dr. F. M. Sandwith, Gresham professor of physic, at the City of London School, Victoria Embankment, E.C. The lectures are free to the public, and will begin each evening at six o'clock.

At a recent general meeting of the Liverpool Astronomical Society it was resolved to raise a special fund for the purpose of a memorial to the late Mr. R. C. Johnson, whose long connection with the society, in which he filled the positions of secretary and president, and his services in the interests of astronomical science, suggest that some permanent recognition of his work should be made.

A memorial in marble to the late Sir John Evans, K.C.B., has been placed by his friends in the parish church of Abbot's Langley, Herts—a parish in which Sir John resided for sixty years of his life. The inscription on the tablet records not only the eminence of Sir John Evans in science, but likewise the high administrative and judicial positions he held in the county.

During the last fifty years Profs. Luiji Palmieri, M. S. di Rossi and others, have, with tromometers, microphones, and various other contrivances, endeavoured to record the internal murmurings and thunderings of Vesuvius, Etna, and other volcanoes. One of the last professors of vulcanology at the Royal University of Naples was H. J. Johnston-Lavis, whose work has been chiefly directed to the mineralogy and petrology of volcanoes. Now it is rumoured that Italy is to have a Vulcanological Institute, for the establishment of which the chief governments will be invited to contribute 60,000*l.* Mr. Immanuel Friedlaender, who resides in Naples and has recently published a work on the volcanoes of Japan, has promised, it is said, 4000*l.* towards this fund..

The centenary of the foundation of the publishing firm of B. G. Teubner, of Leipzig, will be commemorated on Friday, March 3. A large number of representatives of science and education have been invited to take part, and hotel accommodation is being arranged on behalf of those who have accepted the invitations.

An oversea flight of about a hundred miles was made by Mr. McCurdy on January 30 with an aëroplane of the Curtis type, weighing 750 lb. and possessing a 60-horse-power motor. Mr. McCurdy attempted to fly from Key West, Florida, to Havana, a distance of about 110 miles across the Florida Straits. When about ten miles from his destination he had to descend on account of the lubricating oil having been exhausted. The aëroplane was equipped with pontoons, which enabled the descent upon the sea to be made without injury to it or the airman.

The British South Africa Company, Reuter's Agency states, has decided upon the despatch of a special commission to investigate sleeping sickness in Rhodesia. The commission will consist of Dr. Aylmer May, principal medical officer of northern Rhodesia; Dr. A. Kinghorn, of the Liverpool School of Tropical Medicine; Dr. Leach, of the Northern Rhodesian Medical Service; Mr. O. Silverlock, entomologist; and Mr. Jollyman, bacteriologist. As explained in Nature of December 1 (p. 147), it is believed that in north-eastern Rhodesia and Nyasaland sleeping sickness is not transmitted by *Glossina palpalis*, but is probably carried by *G. morsitans*, a species which, unlike *G. palpalis*, is not confined to well-defined and

limited areas in the neighbourhood of water, but is distributed over large districts.

According to a *Times* correspondent at Tiensin, a slight earthquake shock was experienced there at 8.45 a.m. on January 25. A Reuter message says that on January 28 the eruption of a volcano at Taal caused at Manila three strong earthquakes, and nearly a hundred lesser shocks. A later message states that towns for a radius of twenty miles are suffering from a rain of mud and stones, due to the volcanic eruption at Taal. Five small villages in the Taal district appear to have been destroyed by a great wave, and no fewer than 400 lives were lost in that region.

The preliminary reading of the Bill for making official time in France coincide with Greenwich time was accepted in the French Senate on January 26, on the understanding that the Paris meridian should still be adopted for naval, astronomical, and cartographical requirements. Decided advantage will accrue from the introduction of uniform time in western Europe, and the Bill before the Senate will be widely welcomed. The essential article of the Bill reads :—" Official time in France and in Algeria shall be Paris mean time put back nine minutes and twenty-one seconds."

On Thursday next, February 9, Dr. P. Chalmers Mitchell will begin a course of three lectures at the Royal Institution on " Problems of Animals in Captivity," and on Saturday, February 11, Dr. Thomas G. Jackson will deliver the first of three lectures on " Architecture : the Byzantine and Romanesque Period." The Friday evening discourse on February 10 will be delivered by Sir Sidney Colvin on " Robert Louis Stevenson," on February 17 by Prof. Henry E. Armstrong on " The Stimulation of Digestive Activity," and on February 24 by Prof. Jean Perrin on " Mouvement Brownien et Realité Moleculaire " (in French).

The theatre of the Museum of the Yorkshire Philosophical Society in York has for several years been a subject of concern to the council. Though larger than most of the theatres belonging to the principal London societies, it is often inconveniently overcrowded. This state of things, we learn from the *Yorkshire Herald* of January 19, is now in a fair way of being remedied. The president of the society, Dr. Tempest Anderson, has decided to apply to the building of a new theatre a sum of money left to him by his sister, the late Mrs. Percy Sladen, to be used for some scientific purpose. The well of the present theatre will be boarded over with either a permanent or movable floor, and this hall will thus become available as a reception room for use before or after the lectures, and also for smaller meetings. The new theatre will be built at the west side of the present building, space being reserved in front of it for a further enlargement of the museum. The proposed theatre will be about 79 feet long and 47 feet wide, and will comfortably seat nearly 400 people. Between the higher tiers of the seating and the basement hall a workroom (39 feet by 26 feet) will be provided.

The Research Defence Society was founded three years ago to make generally known the facts as to experiments on animals in this country, and the regulations under which they are conducted : the immense importance of such experiments to the welfare of mankind, and the great saving of human and animal life and health which is already due to them. Under the presidency of Lord Cromer, and by the untiring efforts of the honorary secretary, Mr. Stephen Paget, the society has done and is doing excellent educational service in the cause of science and humanity. From a short statement just issued of its work during the past year, it appears that since January last twenty-one pamphlets and leaflets have been published by the society upon such subjects as Pasteur, science, and medicine ; plague in India ; diphtheria and antitoxin ; sleeping sickness ; Malta fever ; and humanity and science. There has been a very great increase during the year in the quantity of pamphlets and leaflets distributed, and in the number of addresses and popular lectures, and lantern lectures, given by members of the society in all parts of the country. A large number of the publications has been distributed among public libraries and similar institutes, and also sold in the ordinary way of publication. There are now nearly four thousand members, but it is hoped that many more people in sympathy with its aims will become members or associates of the society, and help to extend its educational work.

Many attempts have been made to synchronise the phonograph or gramophone with the kinematograph, so as to be able to reproduce simultaneously the sounds of the voice, as in singing and speech, while the movements of the face and the bodily gestures of the singer or speaker are depicted on the screen. The difficulty has been twofold : how to obtain the exact synchronism and how so to intensify the vocal sounds, or rather the mechanism for recording the vocal sounds, as to allow the sound-recorder to be placed at something like the same distance from the speaker as that between the speaker and the kinematograph. The difficulties, however, appear to have been surmounted by M. Gaumont. In *La Nature* of December 31 last, an interesting description is given of a meeting, on December 27, of the Paris Academy of Sciences, at which, by means of M. Gaumont's method, there appeared on the screen an image of M. d'Arsonval which made gestures and delivered an explanatory speech. The details of the method are not fully developed, but they are to be made public without delay. It appears that M. Gaumont has been struggling with experimental difficulties for more than eight years. We may soon have in our homes the *chefs-d'oeuvre* of our theatres played by our best actors, and even lectures by famous professors may not be restricted to their class-rooms, but the speakers may be both seen and heard at so much a yard. Such reproductions are to be called *phonoscenes*. We may well say with Dominie Sampson—" prodigious " !

The syllabus for the first half of the present year of the North London Natural History Society provides plenty of opportunities for those members who wish to do serious out-door work in their subject, as well as to attend lectures and meetings for discussion. The session opened on January 10, when Mr. M. Greenwood, the president, delivered his presidential address, taking for his subject " Science from the Non-professional Standpoint." He laid great emphasis on the value of amateur science, and reminded the members that it has been said the amateur is the glory of British research. " Remember that the greatest biologist our country has produced, Charles Darwin, was an amateur." Mr. Greenwood summarised the leading principles of a great man of science as patience in labouring, impartiality in judging, absolute candour in stating the conclusions to which his researches lead him, and a resolute scorn of the idols of the market-place. The function of science in the life of a non-professional student is of high importance, he said, and that to draw the utmost advantage from his work it is well for such a student to concentrate his energies upon a limited number of subjects, and, above all, to devote original, independent

thought to whatever he undertakes. "The fundamentally valuable thing in scientific study is the mental attitude it engenders. It is doubtless true that we, as a nation, do not spend enough money on pure research and technical instruction; but behind and beyond all this lies our chief national sin—a contempt for scientific reasoning, a striving after short cuts to knowledge, and a slovenly omniscience, as witnessed in our love for examinations and worship of success, *qua* success." Particulars concerning the society may be obtained from the secretaries, Messrs. S. W. Bradley and T. R. Brooke, 12 Warren Road, Chingford, N.E.

Dr. F. Grön makes some remarks in *l'Anthropologie* (Tome xxi., p. 625) on the prehistoric operation described by Prof. Manouvrier by the term "T sincipital." This is a T-shaped groove of variable depth that is found in certain Neolithic skulls, which extends along the sagittal and lambdoidal sutures. Skulls of all ages, from prehistoric to recent times, and from many countries, have been collected which show indubitable evidence of trepanation. These perforations are generally admitted to be surgical operations in order to alleviate pain or to cure certain diseases. Celsius, speaking of malaria of the eyes, refers to a curative operation of cutting the skin by sagittal and frontal incisions, but Dr. Grön does not consider that this is the same operation as that under consideration. He directs attention to the fact that all the skulls found in France with the "T sincipital" are those of women, and puts forward the view that it was not a prehistoric operation undertaken for medical reasons, but a form of punishment of which the vestige is found in the stigmata of historic times. The author adds:—"Certainly this opinion is only a hypothesis."

In an interesting paper presented to the research department of the Royal Geographical Society on January 19, Messrs. A. J. B. Wace and M. S. Thompson discuss the distribution of early civilisation in northern Greece in relation to its geographical features, and in particular the communications through the mountain passes and the forests of Thessaly, which in ancient times seem to have extended over a much wider area than that which they occupy at present. These remains generally take the form of high or low mounds, most of them situated in the plains, but a few are to be found in the foothills. Both of these types must be distinguished from the conical mounds covering Hellenistic tombs, which extend into the prehistoric area. The civilisation of the race occupying these sites is of a primitive type, widely different from the more advanced Minoan culture of the south, which apparently reached northern Greece in its latest phase, and did not replace the local cultures. The co-existence of this northern Neolithic culture with the use of bronze further south must be taken into account in considering the usually accepted view that the Achæans were invaders from the north.

The expedition of the Duke of the Abruzzi to the Karakoram Himalayas is described by Dr. Filippo de Filippi in the January number of the *Geographical Journal*. In spite of many difficulties, much useful and important work was accomplished. Sedimentary and crystalline rocks were found, constituting different portions of the region traversed, and peaks rising well above 20,000 feet occurred in each. Measurements at the beginning and end of the expedition on the Baltoro glacier gave the average movement as 5½ feet a day during June and July; some articles of equipment left on the upper Goodwin-Austen glacier by the Eckenstein-Wessely-Guillarmod expedition in 1902 furnished another means of measurement, and here the movement was less than a mile in seven years, or an average rate of barely 2 feet a day. Aneroid observations were found to be unsatisfactory, but valuable work was done by photogrammetry supplemented by theodolite observations, and in this way much was accomplished in spite of the unfavourable weather.

Bulletin No. 19 of the Agricultural Research Institute at Pusa is devoted to a list of the vernacular, scientific, and English names of the commoner Indian insects.

The *Scientific American* for January 7 contains a long illustrated article on the New York Zoological Park, which embraces an area of 264 acres, and contains at the present time more than 5000 wild animals. That the park is highly appreciated by New York people may be inferred by the fact that 1,614,953 persons passed the turnstiles last year. Attention is specially directed to a huge open-air bird-cage, with a ground-area of 152 by 75 feet, and a height of 55 feet, and enclosing three fair-sized forest trees and a pond of 100 feet in length. Naturally, the authorities have endeavoured to exhibit a representative series of the animals of North America, among which at the present time a special feature is the show of the various forms of huge brown bears inhabiting Alaska. A new and noteworthy exhibit is the herd of six musk-ox calves, five of which were recently received from Ellesmere Land, Greenland, as the gift of Paul J. Rainey. "Miss Melville," the sixth specimen, arrived a year ago from Melville Island. These six constitute the only live herd of these animals in captivity.

In its January issue, the *American Naturalist* prints an address on "organic response," delivered by Dr. D. T. Macdougal, the president, before the meeting of the Society of American Naturalists held at Ithaca, N.Y., on December 29, 1910. The article is of such length that it is difficult to give a *prècis* of its scope within the normal limit of a note in this column. The chief subject is, however, the changes undergone by animals and plants under different conditions of environment, especially as the result of artificial transportation or transplantation. After alluding to the peculiar suitability of micro-organisms with a short life-cycle to experiments of this nature, and the results obtained therefrom, Dr. Macdougal refers to the difference in the breeding habits of the spotted salamander according as to whether it lives at high or low levels, the species being viviparous under the former and ovoviviparous under the latter conditions. It is added that if the Alpine black salamander be kept in a high temperature, its larvæ resemble those of the spotted species when in its lower habitat, whereas if the spotted kind be kept in a low temperature, its reproductive habits and young approximate to those of its black relative. Attention is next directed to the results obtained by transporting beetles to habitats unlike their own, after which comes a fuller account of the American experiments in regard to growing selected kinds of plants at different elevations and under different conditions of climate and soil. These experiments are being conducted on a very extensive scale, large "xero-montane," "montane," "maritime," and other types of plantations having been established in California, Arizona, and elsewhere. For the results of these our readers must refer to the address itself.

In the latter part of the article on sexual dimorphism in plants, published in the *Biologisches Centralblatt* (November 15, 1910), Prof. Goebel describes some anomalous features observable in flowers of the Compositæ. Generally, as in Calendula, the female ray florets

are larger than the hermaphrodite or the male tubular florets. But in *Homogyne alpina*, *Cotula coronopifolia*, and species of Xanthium the female flowers are smaller. In *Petasites niveus*, which is diœcious, the inflorescence of female flowers grows considerably after the flowering period, while the inflorescence of male flowers remains small; yet the female flowers individually are much smaller than the male, especially in the corolla. The author suggests that these anomalies may be explained as the result of two opposite tendencies, the one to enlarge the corolla for show, as in the ray florets, the other, frequent in unisexual flowers, to reduce the corolla.

A VIVID sketch of two botanical excursions in the south-west region of West Australia is communicated by Captain A. Dorrien-Smith to the Journal of the Royal Horticultural Society (vol. xxxvi., part ii.), where the author says that the magnificence of the flora surpasses that of any other region he has visited. In the neighbourhood of Cape Naturaliste, *Banksia grandis*, *B. attenuata*, a blue Leschenaultia, and *Templetonia retusa* were conspicuous. The finest display was encountered at Warrangup Hill (2800 feet), in the Stirling Range, where a giant white Epacrid, *Lysinema ciliatum*, tall bushes of a pink-flowered Protead, *Isopogon latifolius*, and the golden-flowered *Dryandra formosa* attracted special attention. Another vegetation sketch, ecological rather than floristic, in the same number deals with rare wild flowers in the west of Ireland, in which Mr. Lloyd Praeger describes, and in some measure explains, their peculiar distribution. The article is recommended to students as an admirable essay on a unique and instructive combination of ecological problems.

HAVING regard to the recent consummation of the Union of South Africa, Prof. H. W. Pearson took advantage of an opportune occasion to lay before the biological section of the South African Association for the Advancement of Science during last November, in his presidential address, the great desirability and advantages of a South African National Botanic Garden. In the first instance, Prof. Pearson, while assigning due credit to the work of existing institutions, notably the Natal Botanic Garden ably administered by Mr. Medley Wood, pointed out that none of these provides sufficient area or is situated in a suitable locality for an establishment or State department, which should comprise not only horticultural departments, an experimental garden and herbarium with library, but also a museum of economic products, research laboratories and a staff of technical assistants and plant collectors. Chief among the arguments advanced are the non-existence of a garden where the unique plants of South Africa are grown and investigated, the necessity for the study of the veld vegetation with a view to the improvement of the fodder grasses, and the desirability of extended botanical exploration.

THE REV. M. SADERRA MASÓ, who has for many years studied the earthquakes of the Philippine Islands, is now turning his attention to the subterranean noises known in other countries under various names, such as mist-pœffeurs, marinas, brontidi, retumbos, &c. In the Philippines many terms are used, generally signifying merely rumbling or noise, while a few indicate that the noises are supposed to proceed from the sea or from mountains or clouds. Most of the places where they are observed lie along the coasts of inter-island seas or on enclosed bays; very few are situated on the open coast. The noises are heard most frequently at nightfall, during the night and in the early morning, especially in the hot months of March, April, and May, though in the towns of the Pangasinan province they are confined almost entirely to the rainy season. They are compared in 70 per cent. of the records to thunder. With rare exceptions, they seem to come from the mountains inland. The instances in which the noises show any connection with earthquakes are few, and observers usually distinguish between them and the low rumblings which occasionally precede earthquakes. It is a common opinion among the Filipinos that the noises are the effect of waves breaking on the beach or into caverns, and that they are intimately connected with changes in the weather, generally with impending typhoons. Father Saderra Masó is inclined to agree with this view in certain cases. The typhoons in the Philippines sometimes cause very heavy swells, which are propagated more than a thousand kilometres, and hence arrive days before the wind acquires any appreciable force. He suggests that special atmospheric conditions may be responsible for the great distances to which the sounds are heard, and that their apparent inland origin may be due to reflection, possibly from the cumulus clouds which crown the neighbouring mountains, while the direct sound-waves are shut off by walls of vegetation or inequalities in the ground.

THE Berne correspondent of the *Morning Post* (January 20) states that a fall of what has been called "black" snow, which occurred recently in the Lower Emmen Valley, has caused a great deal of interest in Switzerland. The most reasonable explanation put forward is that in certain conditions of weather snow may take an appearance of blackness which is quite deceptive. It appears that after the snowfall there was a slight thaw, and a very fine rain fell. While it was still raining, the "Bise," a piercing cold and dry north or north-east wind, set in, and froze the rain on the surface of the snow. Underneath the crust of pure ice thus formed there was a small air-filled space, and the light when reflected from the snow beneath produced to the eye a dark appearance. We find that in the "Glaciers of the Alps" (p. 204) Tyndall refers to another optical effect caused by the condition of the snow on the Montanvert in winter, in which "the portions most exposed to the light seemed least illuminated, and their defect in this respect made them appear as if a light-brown dust had been strewn over them."

ACCORDING to usual practice, Dr. H. R. Mill has communicated to the *Times* (January 17) a preliminary statement of the general character of the rainfall of 1910, and also an abridged summary of the same to *Symons's Meteorological Magazine* for January. As we have already referred (January 5) to statistics prepared from another source, we need only quote here some of the leading features shown by Dr. Mill's first examination of about 3000 records of the British Rainfall Organisation. The results, which are exhibited by maps, and by carefully prepared tables for stations and districts, show that the British Isles, as a whole, had an excess of 8 per cent.; Wales had an excess of 17 per cent.; southern England, 16 per cent.; Ireland, 9 per cent.; northern England and Scotland, less than 5 per cent. The relatively wettest area was in portions of Somerset and Monmouth, where the excess exceeded 30 per cent. A very wet area extended through Devon and Cornwall, along Dorset, Wiltshire, Hampshire, and Sussex, also to Hereford and part of Wales, but in many places the rainfall was below the average, especially on the coasts. The year had one of the wettest Februaries and one of the driest Septembers on record. Dr. Mill remarks that the relation of two dry

years followed by a wet year, which prevailed for England and Wales for twenty-one years, including 1909, has now completely broken down, and that it seems possible that the swing of the pendulum is carrying us into a period of predominating wet years, corresponding to the wet period of 1874–83.

In the *Memorie del R. Istituto Lombardo di Scienze e Lettere* Signor A. M. Pizzagalli has published a memoir, "La cosmogonia di Bhṛgu," an investigation of the relation of the cosmogonic myth to the epics of India. The cosmogony of Bhṛgu is part of one of the subdivisions of the twelfth book of the Mahabharata; it is in the form of a dialogue between two legendary persons, Baradvāja and Bhṛgu, the former asking questions, the latter answering them. It deals with the origin of all things in the animal as well as in the vegetable world, which are supposed to have the same composition and to be essentially identical. It shows how the vital flame combines with the earth-element to form the body of the individual, while the soul, an efflux of the Supreme Being, pervades and rules the body and endows it with various qualities. A complete translation of the dialogue is given; there is nothing astronomical in it.

"The Structural Design of Aëroplanes" forms the title of a paper read before the Institution of Civil Engineers of Ireland by Prof. Herbert Chatley about a twelvemonth ago, and now reprinted (Dublin: John Falconer, 1910). In it the author endeavours to apply exact mathematical methods to the calculation of the stresses in the sustaining framework of an aëroplane, as well as in the supporting surfaces. In view of the number of deaths that have resulted in the past year from breakages of aëroplanes, the alternative causes frequently being instability, it ought to be evident that the only way of placing the problem of aviation on a satisfactory basis, and of preventing future fatalities, is by encouraging the further development of investigations such as Prof. Chatley's, and by determining exeprimentally the unknown data which such investigations show to be necessary in order to complete the solutions of such problems—the latter being evidently a comparatively easy task. In the discussion on the paper, however, we notice the usual want of appreciation of the methods of exact science on the part of so-called "practical men."

M. Gilbert Maire contributes to *La Revue des Idées* for November 15, 1910, an account of an interesting medico-psychological study of Prof. Henri Poincaré undertaken by Dr. Toulouse. Owing to the wide public interest which has been aroused, especially in France, by Poincaré's writings on the philosophy of science and on the concepts of mathematics, many readers will wonder how and under what conditions Poincaré originates his investigations. It is evident from the present account that when absorbed in a problem Poincaré has often, like many another genius, become oblivious to matters of everyday life. What seems, however, to have most impressed Dr. Toulouse was that Poincaré's discoveries were not arrived at as the result of a concentration of mental effort, but that they have come on him spontaneously, often when his thoughts have been turned in quite different directions. For this kind of faculty Dr. Toulouse has proposed the name "auto conduction." Whether a new name was really needed, or whether the same faculty has already been recognised and described under other names, is a matter on which there may be more than one opinion. At the same time, the fact that Poincaré, and probably many other philosophers, and especially mathematicians, became suddenly inspired by new ideas (and, indeed, find it impossible to throw these ideas on one side, even temporarily, until they have developed them), affords an interesting problem for the psychologist, and Dr. Toulouse's examination may well direct attention to this problem.

The four numbers of the Journal of the Royal Society of Arts ending with that of January 13 contain the text of the Cantor lectures on industrial pyrometry which have been delivered before the Society by Mr. C. R. Darling. The last two lectures concern themselves mainly with the simplified forms of the platinum thermometer, the thermo-junction, and the radiation pyrometer, which have been constructed for use in works where observational skill on the part of the users cannot be taken for granted. Several of the methods described have received attention in these columns as they have been developed from those suitable for more accurate work.

More than forty pages of the number of *Himmel und Erde* for December 30, 1910, are devoted to addresses on the principle of relativity which have been delivered before scientific societies in Germany during the past year. The first of these, delivered by Prof. E. Cohn, of Strassburg, before the Scientific and Medical Society of that city, aims at a clear exposition of the principle to an audience to whom it was comparatively unknown, and it succeeds admirably in its object by the help of experiments performed with an ingenious model designed for the purpose. The second, delivered by Prof. H. Poincaré, of Paris, before the Scientific Society of Berlin, goes somewhat more fully into the reasons which have led to the extension to general physics of a principle as old as Galileo and Newton, that our knowledge of the motion of any body can only be of its motion with respect to some other body. When this principle is traced to its logical conclusion in relation to the known facts about the speed of light, it leads to the denial of most of the laws of the old mechanics. The units of mass, length, and time on one moving body will differ from those on another moving body by amounts which depend on the relative motions of the bodies with respect to each other. Prof. Poincaré is not disposed to accept the principle as fundamental throughout physics, and points out many of the difficulties which still have to be overcome before it can be regarded as altogether satisfactory.

We have just had the opportunity of trying the "tabloid" preparations of Messrs. Burroughs Wellcome and Co. as specially arranged for colour photography by the single-plate (or screen-plate) processes. They give excellent results, and the uniformity which the use of tabloids ensures eliminates a fruitful source of uncertainty that too often spoils the work of those who use such plates at irregular intervals. The formulæ given are suitable for the Autochrome, Thames, Ominicolore, and Dufay plates. The cartons are three only—the developer, the reversing compound, and the intensifier, the last often being unnecessary.

A paper on the inversion of cane-sugar under the influence of acids and neutral salts, by Mr. Noël Deerr, has been issued as Bulletin No. 35 of the Agricultural and Chemical Series of the Experiment Station of the Hawaiian Sugar Planters' Association. The author has determined the influence of twenty-three different salts upon the rate of inversion of cane-sugar by hydrochloric and other acids.

The *Bio-Chemical Journal* of January 17 contains an article, by Prof. B. Moore, "In Memory of Sidney Ringer

[1835–1910]. Some Account of the Fundamental Discoveries of the Great Pioneer of the Bio-chemistry of Crystallo-colloids in Living Cells." This may be regarded as supplementing the biographical notice of Ringer's career, and of his work as a clinician, which is to be found in the *British Medical Journal* of October 29, 1910.

We have received from Messrs. E. Merck, of Darmstadt, a copy of the third German edition of their "Index" of pharmaceutical preparations. Eight years have elapsed since the second edition was issued, and the index now forms a handsome volume of nearly 400 pages. Copies of the new edition can be procured from the London agent of the firm.

The properties of binary mixtures of some liquefied gases are described in the Journal of the Chemical Society by Dr. B. D. Steele and Mr. L. S. Bagster, of Melbourne University. The mixtures chosen were those of sulphur dioxide with hydrogen bromide, and hydrogen sulphide with hydrogen bromide and with hydrogen iodide. The vapour pressures were plotted for a series of temperatures from $-35°$ to $-75°$. A mixture of hydrogen sulphide and hydrogen bromide in the proportion of 60 to 40 was found to have a minimum vapour pressure (or maximum boiling point, analogous to those observed in mixtures of water with the halogen acids), in spite of the fact that the solutions are non-conductors and have given no evidence either of ionisation or of association. Mixtures of hydrogen sulphide and hydrogen iodide, on the other hand, gave direct linear relationships between total vapour pressure and composition (of liquid) and between the vapour pressures of the two constituents and the concentration of the liquid, thus adding another to the very short list of pairs of liquids which obey Raoult's law throughout the whole range of compositions.

The fourth volume of the Journal of the Institute of Metals is now available. It has been edited by Mr. G. Shaw Scott, the secretary of the society, and copies may be purchased at the offices of the institute, price 21s. net. The greater part of the volume consists of the papers of scientific interest read at the annual autumn meeting of the institute held in Glasgow last September, abstracts of which were published in Nature of September 29 (vol. lxxxiv., p. 421). These papers are in the volume supplemented by written communications from eminent authorities after the papers were read. The first May lecture, which was delivered by Prof. W. Gowland, F.R.S., is also included, together with a series of abstracts of papers relating to the non-ferrous metals and the industries connected with them.

OUR ASTRONOMICAL COLUMN.

Splendid Meteor on January 25.—Mr. W. F. Denning writes:—"St. Paul's Day, January 25, has been noted in past years for occasionally supplying very large meteors, and it has maintained its character this year.

"A fireball was seen at 7h. 5m. p.m. by Mr. J. L. Haughton, of Birmingham, falling very slowly from the region of Aldebaran in Taurus to κ Orionis. The meteor was more brilliant than Venus at her best, but there were some clouds in the sky, which prevented the best effects being observed and interfered with the accuracy of the record. Near Leeds, Mr. J. H. Park witnessed the meteor sailing very slowly along from the north-west to south-east, and passing south-west of the Pleiades. The heavens were much overcast, and only a few stars visible.

"The probable radiant of the fireball was in Cepheus at $330° + 58°$, and it apparently belonged to the same stream as that which supplied the magnificent fireball of January 25, 1894. The recent one passed from over Monmouth to Wiltshire at a height of about 83 to 46 miles, but additional observations are required."

Nova Lacertæ.—In No. 4466 of the *Astronomische Nachrichten* Dr. Max Wolf publishes a reproduction of the region about Nova Lacertæ from a photograph taken on January 2 with an exposure of thirty-one minutes. The reproduction covers a circular region of 1° diameter, with the nova at the centre, and shows stars to about the fifteenth magnitude; the B.D. comparison stars are especially marked. The earlier plates on which a star of magnitude twelve or thirteen is shown in the nova's position were taken on July 15, 1904 (exposure 3h. 46m.) and January 9 and 11, 1894 (2h. 30m. exposure), the former with the Bruce and the latter with the 6-inch telescope. In No. 4467 of the same journal the result of a comparison of positions of this faint object and the nova is announced, and it seems reasonably certain that they are identical—that the star took part in the catastrophe producing the nova.

The identity is confirmed by Prof. Barnard, who, in No. 4468 of the *Astronomische Nachrichten*, states that he has found the image of a fourteenth-magnitude star in the place of the nova on plates taken on August 7, 1907, August 22 and 24, 1909, and October 11, 1893. On the first-named plate the position of the image agrees within 0·01s. in R.A. and 0·1″ in dec., with the nova's position as determined with the 40-inch micrometer. In the 40-inch telescope the nova has two distinct and sharp foci, such as were also exhibited by Nova Geminorum (1903), the one being 8 mm. further from the object-glass than the other. Prof. Barnard has never noted this peculiarity in other stars, and ascribes it to the great brilliance of the crimson $H\alpha$ line of hydrogen, as shown on the Yerkes spectrograms.

For January 10 and 16 Prof. Millosevich gives the magnitude of the nova as 7·4 and 7·7 respectively.

Dr. Münch obtained a spectrogram with a 15-cm. objective prism used with the Zeiss triplet of the Potsdam Observatory on January 6 and 7, and the same prism was used, by Dr. Eberhard, in connection with the 30-cm. reflector on January 8. The plates show a continuous spectrum crossed by a number of bright lines. The hydrogen lines $H\alpha$–$H\eta$ are bright and very broad, and there is a very bright band at λ 4654. A broad absorption band appears on the more refrangible side of $H\gamma$, a bright emission line is seen at λ 4056, and near it, at λ 4045, there is a distinct absorption line; the K line is much fainter than would be expected from the brightness of the emission lines.

A plate taken by Prof. Hertzsprung on May 22, 1910, shows no trace of the nova, which was then certainly fainter than the eleventh magnitude.

M. Felix de Roy, Antwerp, found the magnitude of the nova on January 7 to be 7·8, and the colour was about 6c on Osthoff's scale. A telegram from Herr Mewes, Breslau, states that the nova was exceedingly red on January 14.

Absorbing Matter in Space.—In No. 5 of the Transvaal Observatory Circulars Mr. Innes discusses the blank region of the sky around the star S. Corona Aust., and suggests that the apparent vacuity may be the result of the interposition of an absorbing medium which cuts off the light of the stars behind it. Messrs. Innes and Worssell find that in one part of the region the field of the 9-inch refractor (25′) includes no star of any magnitude. The latter also considers that he is able to detect a distinct difference in tint on passing the border of the blank and starry parts of the sky; the region is probably unique. Some of the stars appear to be surrounded by nebulous matter, but the small dark patches—seen on a photograph reproduced on Plate xxii.—are the most remarkable objects. Mr. Innes suggests that all the phenomena could be best explained by supposing that irregular sheafs of gas, some of which are dark and opaque, others slightly luminous at their extremities, cover the region. Where this gas is impenetrable no stars are seen; rifts in it allow other stars to appear; and where it is slightly luminous the stars behind it appear with circumjacent nebulosities.

In 1899–1901 the tenth-magnitude star Cor.D.M. $-36°$ 13208 was recorded by Mr. Innes as "not seen,"

but Mr. Worssell found it visible—and probably variable—in 1909–10, its magnitude ranging from 11·0 (1909 July 21) to 12·2 (1909 September 5). This star lies on the border of the abnormally tinted patch of the sky, and it is suggested that its disappearance in 1899–1901 may have been due to a slight extension of the obscuring medium, which is now retreating.

Photographic Determinations of Stellar Parallax.—To No. 5, vol. xxxii., of the *Astrophysical Journal* Prof. F. Schlesinger contributes the first part of a paper on the photographic determinations of stellar parallax made with the Yerkes refractor. Previous parallax determinations have usually been made with short-focus instruments, and it occurred to Prof. Schlesinger, in 1902, that the errors of observation might be greatly reduced if much greater focal lengths were employed; the cooperation of the Yerkes authorities and the Carnegie Institution rendered this possible, and 327 plates, relating to twenty-five different regions, were secured, and have been reduced for the purposes of the present papers.

In this first paper Dr. Schlesinger describes in detail the apparatus and methods employed in securing the photographs. The question of using screens, for the sharpening of the stellar images, was considered, but it was decided not to use them, as difficulties might be introduced; also, it was found that, with the 40-inch objective used with Cramer Instantaneous Isochromatic plates, they were really unnecessary. A special movable plate-carrier, adjustable in two directions by means of screws, was employed, and the coincidence of the optical axis and the geometrical centre of the plate was investigated; it was found that they were separated on the plate by about 8 cm. (about fourteen minutes of arc), but the final effect was negligible, and, as the radical correction of the tilt would have interfered with other instruments used with the 40-inch, no attempt was made to correct it. The focussing each evening was done visually by means of an eye-piece sliding on a graduated scale. The "hour-angle error," produced by atmospheric dispersion, was eliminated, so far as possible, by choosing the hour-angle at which each plate was exposed; it was also deemed advisable to use the telescope on one side of the pillar only, in order to eliminate "optical distortion." After several experiments an ingenious "rotating disc" occulting shutter was employed for reducing the brightness of the parallax star to that of the surrounding comparison stars.

Many other interesting points are discussed by Dr. Schlesinger, but space does not permit of their being mentioned here. It may, however, be added that the scale of the plates is such that 1 mm. corresponds to 10·6″, and that 20 cm. × 25 cm. plates were used.

Lines in the Spectra of Nebulæ.—No. 183 of the Lick Observatory Bulletins contains a list of nebula lines discovered photographically by Dr. W. H. Wright. In the great nebula of Orion he finds lines at λ 3734 (faint), λ 3722 (v. faint), λ 3712 (v.v. faint), and λ 3704 (v. faint), all of which he ascribes to hydrogen; another line is suspected at λ 4137.

In N.G.C. 7027 lines were found at λ 6301, λ 6548, and λ 6583, the latter two making a conspicuous triplet with $H\alpha$, which is very bright in all the nebulæ that have been observed.

Utilisation of the Sun's Heat.—In the January number of *L'Astronomie*—to which title the *Bulletin de la Société astronomique de France* has reverted—Prof. Ceraski describes and illustrates a very simple thermo-electric pile which he made and which gives sufficient current to ring an electric bell whenever the sun shines. He also suggests, hesitatingly, that if made up in sufficient numbers and placed in suitable localities, batteries of such piles might be employed in utilising the solar radiations.

PROPOSED CALENDAR REFORM.

PROPOSALS for reformation of the calendar have been somewhat numerous of late years, and few of the proposers appear to have a full sense of how much trouble and inconvenience any alteration would cause, and, of course, the more radical the change is the greater this would be. Mr. T. C. Chamberlin, indeed, who puts forth another scheme in the number of *Science* for November 25, 1910, admits that it is important that if any alteration is adopted, its advantages should be so great and so unique that no further modification of it would ever appear desirable.

Now all the alterations lately proposed, including the one before us, are of a far more drastic kind than the Julian and Gregorian reforms, which only aimed at securing that the monthly and other dates in the calendar should correspond to the season of the year, the whole length of the calendar year being of the same length as a tropical year. Even in the time of Julius Cæsar it was known that the length of the latter was a few minutes less than 365¼ days. Following the practice of the old Egyptians (and guided partly by the advice of Sosigenes), when he made the Roman calendar wholly solar, he probably thought that it would be better, because simpler, to take the length of the year as 365¼ days, and that this would secure the correspondence with the seasons for a sufficiently long period. As time went on, of course, the difference between this and the true length became more accurately known.

The ecclesiastical authorities, in arranging the cycles for the observance of Easter, considered it essential that, though that feast was movable on account of its being taken as dependent on the Jewish Passover, which was regulated by the moon, yet it was necessary to take the moon the full of which followed the vernal equinox, and to give that equinox the date which it had (or was supposed to have) at the time of the first great Council of the Church, that of Nicæa. To do this it was necessary, not only to alter in future the length of the calendar year, but to drop the days, then ten in number, by which the date of the equinox had changed since the time of the Council.

The Gregorian alteration, then, was introduced in 1582; but the Reformation of the Church, which had then been accepted in many countries in the north of Europe, led to this change being opposed by them, though it was ultimately adopted all over western Europe, and consequently in North America.

But the changes we are now called upon to discuss are of a very different nature. Most of the proposers seem to think there would be very special advantage in making artificial arrangements by which the days of the week should correspond to those of the month, which, of course, could only be effected by making every month 28 days (or 4 weeks) in length. Some would increase the number of months in each year to 13, and as $13 \times 28 = 364$, suggest that the correspondence might be maintained by treating one day as a *dies non*, which would have to be made two in leap-years. But it would not be possible to treat a day as *dies non* in any complete sense. It could, of course, easily be made a holiday, but even in holidays all must do something, and many a great deal.

The peculiarity of Mr. Chamberlin's plan seems to be to retain our 12 months, but at the end of each quarter, or period of three months, to insert a week with a special designation, the thirteenth week of the year to be called Easter week, the twenty-sixth Julian week, the thirty-ninth Gregorian week, and the fifty-second Christmas week. The idea seems to be that a week is needed at the end of each quarter for arranging accounts and other matters.

Having set forth the salient points in this fresh attempt at symmetry in the calendar, we leave it to our readers to form their opinion about whether changes of this drastic nature would procure advantages comparable with the trouble caused. Many, no doubt, will be reminded of the famous interrogatory of Lord Melbourne.

The same remark, in the writer's opinion, may be made of another proposal by M. Grosclaude, of Geneva, for which the approval of a congress at Brussels is claimed. According to this, the year would consist of four quarters, each containing thirteen weeks; but while the first two months of each quarter would have only thirty days, the third would have thirty-one. This would give the year 364 days; the remaining day (two, of course, in leap-year) would be made up as in Mr. Chamberlin's plan.

W. T. L.

MODERN ARGENTINA.[1]

FEW countries outside the British Dominions are more interesting to the inhabitants of Great Britain than the Argentine Republic. Enormous amounts of British capital are invested there—some 170,000,000*l.* in the railways alone, indeed Great Britain has financed most of the developments—about a quarter of our imported foodstuffs come from there, and a number of young Englishmen go out to find employment on the great estancias. At present the bulk of the population centres round Buenos Aires, the enormous hinterland being only thinly populated, and in many regions not thoroughly explored. And yet the country is not new; it has a history of three centuries, two of which, however, were under the old Spanish *régime*, when only Spanish emigration was permitted, and the few adventurers and officials who went out preferred the life of the town to that of the country.

The administration in 1907 very wisely determined to take stock of the present agricultural position, and a scheme for a census, or, more strictly, a great inventory, was drawn up. It was, however, necessary to proceed cautiously, and for some time an advertising campaign was conducted informing the people exactly what information was wanted, and why. The census was taken in 1908, and the results are now published; there are two volumes of figures, and one volume devoted to monographs dealing with the physical conditions, the agriculture, and the people.

From these volumes we learn that the Argentine is now growing at a good, but not very rapid, rate. Of its 4,500,000 inhabitants in 1900, about a million were foreigners, nearly half being Italians, followed by Spaniards and Americans; under 22,000 are English. The exports are wheat, maize, linseed (Argentine being the chief producer of this) and other cereals, meat, both chilled and tinned, hay, quebracho (used for tanning), and similar commodities, the total value being in 1909 79,000,000*l.* Formerly it was mainly a grazing country, but of late years crops have been grown extensively.

The wheat supply from the Argentine has an interesting history. As in other newly settled countries—*e.g.* Canada—wheat is one of the earliest crops the newcomer grows, because it requires but little capital and trouble, and is always saleable. But wheat does not necessarily remain the staple crop; in the more closely settled parts of Canada mixed farming comes into greater prominence, and in the Argentine wheat gives place to lucerne, which yields valuable hay, and is also excellent for cattle food. In improving land, the usual method is to plough it up and sow maize, then linseed, then wheat, and finally lucerne, which is left for hay and the cattle, the colonist moving on to break up more ground. There is this difference between the Argentine and other new countries, that in the Argentine much of the land is already owned by absentee landlords, who put in a manager—commonly an Englishman, who does well as a rule—but do not themselves take any part in the development. The system is admittedly bad, but it is a legacy from the old days, and is not easily displaced. The agriculture is, however, sound; lucerne enriches the soil in nitrogenous organic matter, and leaves it in a fertile condition for any subsequent arable crop that may be taken.

Geologically, the surface of the country is mainly derived from Tertiary and later formations; the Archæan occurs only in small and isolated patches; the Silurian occurs extensively in a few districts; the Devonian runs from north to south, and contains a certain amount of coal; the lower Triassic has not yet been found, but the Jurassic has, and agrees well with the formation as found elsewhere. It is, however, not prominent in the Argentine, and has not been found east of the Pampean ranges and on the plains. The Cretaceous system is well marked, running north to south, but does not cover a wide tract of country. The great plains and the Pampas are formed of loess, a fine-grained sand varying from light to dark grey in colour, and containing calcareous nodules; the origin of this deposit is not settled, but the current idea seems to be that sea water, fresh water, and wind have all played an important part in its formation. One general feature is that the soil is so rich in salts that it not infrequently deposits a white efflorescence containing sodium chloride and sulphate with other salts. Nine different groups of flora are distinguished: the Antarctic forest in the south, consisting mainly of beech with some cypress; the Patagonian, in a dryer region, comprising herbaceous plants, shrubs, and trees; the Pampean, in a moister region, absolutely without trees, consisting of Gramineæ, Compositæ, and Leguminosæ; then further north, in another dry region, the Chañar, or bush flora, especially mimosas; and further north again the subtropical region, the garden of the Argentine. Of the other four regions, one in the north-west is desert and one in between the rivers is bush. Why the Pampas should be without trees when trees occur in the surrounding dryer regions is not clear.

Turning again to the agriculture, cattle are of great importance, but sheep, as in other countries, are diminishing in number. The stock is being steadily improved; some of our best pedigree bulls and rams are imported, and the Argentine buyer never hesitates to secure what he considers suitable animals, whatever the price may be. The decrease in the number of sheep is considerable, and is attributed to two causes: certain "worms" have proved very fatal, and the sheep have been found to injure lucerne, and therefore have lost favour with the estancieros. This result can only be regretted; sheep are as much wanted as ever, and they are a very valuable support for the agriculture of a country. To cut them out is to narrow the basis on which the system of agriculture is built.

It is clear that the Argentine has some serious problems to face, but the rapid increase in its volume of trade and in its area of land under cultivation justifies the hope that continued progress will be made, and that the country will still retain its high rank among the food-producing countries of the world.

[1] Journal of the Royal Society of Arts, December, 1910.
Argentine Republic—Agricultural and Pastoral Census of the Nation. Stock-breeding and Agriculture in 1908. Vol. i., Stockbreeding, pp xviii+435; vol. ii., Agriculture, pp. x+441; vol. iii., Monographs, pp. xcv+705+xliv plates.
Live Stock and Agricultural Census of the Argentine Republic, May, 1908. 5 maps. (Buenos Aires: Argentine Meteorological Office, 1909.)

METABOLISM IN DIABETES MELLITUS.[1]

THE depth of the tragedy into which the most recent investigators of the disease "diabetes mellitus," whose observations are described in the memoir referred to below, have inquired, is sufficiently indicated by the fact that seven of their ten "severe cases" have died since coming under observation in the early part of 1908. Diabetes is considered as being primarily a disturbance of nutrition tending to develop a condition of starvation, and yet it will be noted that in six of these cases the fatal result is attributed to "diabetic coma." Diabetic coma is in no sense due to any deprivation of nutriment experienced by the central nervous system, but rather to a very real poisoning assignable to an appearance in the blood of unusual chemical compounds or to an appearance of compounds in an unusual quantity which are normally present only in minute traces. Nutrition, in short, is not only deficient, leading to a great emaciation of the patient, but is also disordered, leading to death by internally developed poisons. Medical treatment of this disease, its causation having been fully developed prior to the arrival of the doctor, is therefore directed to maintain nutrition in very adverse circumstances by expert adjustments in the diet, and to secure the elimination, or at least neutralise, the effects due to the presence of these poisons. As a valuable contribution to our knowledge of the principles underlying such treatment, this account of the extremely precise and varied observations of Benedict and Joslin will meet with a wide welcome.

Everyone, taught by numerous and by no means reticent guides to the true ritual of diet, is aware that diets necessarily contain certain nitrogenous materials, "proteins" and certain non-nitrogenous materials, "fats and carbohydrates." Almost as many know that the diabetic patient is incapable of dealing with more than a minimal quantity of carbohydrate material. In his alimentary

[1] "Metabolism in Diabetes Mellitus." By F. G. Benedict and E. P. Joslin. Pp. vi+234. (Washington, U.S.A.: Carnegie Institution, 1910.)

canal carbohydrates are dealt with as efficiently as ever, and the sugar into which they are there converted is absorbed into the body-fluids in normal fashion. There is, however, reason to believe that, once in the body-fluids, this sugar has almost completely lost its normal significance. Instead of being the most readily available of the fuels that are oxidised, and together form the only source of energy for all the mechanical work performed by the body, and within the constituent parts of the body, this sugar is now an almost useless commodity, and is further a harmful adulterant tending to accumulate within boundaries through which it is swept at none too great a pace by mechanisms primarily adapted for the excretion of a different class of material.

In addition, too, there is the sugar which is formed within the tissue-cells by chemical change in the proteins that form another of the absorbed fuels of the body. This further quantity of sugar has the same character and meets with much the same alteration in significance, and so it follows that the proteins absorbed from the diet and the proteins formed within the body cease on this account to possess their original value to the economy. Nor is this all, since there is some reason to believe that the remaining class of fuel, the fats, is—this probably as a secondary consequence—not so well dealt with as normally. Incomplete oxidation of the fats is by some, at least, considered as in part responsible for that rancidity of the blood which finally determines the onset of diabetic coma.

The picture of trouble due to these manifold disturbances in the utilisation of fuel must be limned even still more gloomily if the conclusions of Benedict and Joslin are to meet with acceptance. They find that the diabetic patient is the site of more extensive processes of oxidation than the normal person in similar circumstances. Nothing that they say prevents us from continuing their statement into the necessary corollary, that the "efficiency" of the internal mechanisms of the diabetic patient is lowered. Within these patients a greater usage of oxygen and waste of heat accompanies such performances of mechanical work, such internal displacements of matter, as coincide with the periods of rest during which these observations were made. The diabetic patient, already handicapped by his incapacity to utilise fuel, is still further handicapped by the necessity for utilising a greater quantity of fuel.

Now, in the present writer's opinion, there is nothing in their experimental results to support such a conclusion further than the point where the same fact is seen as true for the normal person with the same relation between body-surface and body-weight. Benedict and Joslin do indeed themselves discuss the possibility that the peculiarity which they discover in the diabetic patient is no more than a peculiarity of the emaciated person, but they dismiss this possibility as incapable of explaining differences of the magnitude they observe. It is a pity, however, that they have not brought their opinion to the test of a quantitative calculation, since the point is of great importance to our knowledge of the normal person as to our knowledge of the diabetic patient. If it is true that in this respect the diabetic patient is no more and no less than an exaggerated normal person, then physiology is obviously in their debt for an extension of physiological inquiry to limits not readily attainable in the ordinary way.

This very definite statement of opinion is, it is held, based soundly upon the fact that their experimental results may be referred to several criteria other than the particular one used by the authors, which not only bring the diabetic patient on to the same level of value as the normal person, but also serve to make the results obtained from their normal persons far more congruous than the authors have made them appear. Indeed, their suspicions might well have been excited by the fact that their method of arranging the experimental results (per kilogram of body-weight) leads to greater discrepancies when dealing even with normal persons than are found when the results are left in the form they were actually obtained (per individual person).

The interested reader of these most valuable experimental data, and the authors themselves, will gain rather than lose respect for the exact outcome of prolonged, highly skilful, and enterprising labour when they observe the manner in which the results can be marshalled into line by the adoption of a new artifice. This will be found to be the case when the quantities of physical and chemical change observed per unit of time are divided, not by W (the weight) and expressed per kilogram, but by $H\sqrt[3]{W}$ (the height multiplied by the cube root of the weight). Whatever the meaning of this new divisor and form of expression, it is a fact that it places the diabetic patient upon the self-same level as the normal person so far as his dissipation of heat and oxygen requirements are concerned. A very probable meaning is that the results are thus referred to the extent of the body-surface, and that per square metre of surface the loss of heat is the same. Accepting for the time being this probability as a fact, then the surface of the body in the emaciated as in the normal person is equal to $2{\cdot}9\ H\sqrt[3]{W}$. Making use of this formula, we can express the results of these experiments as is found below:—

Examined in the "Chair Calorimeter."

	Heat (kalories) dissipated per kilogram and per hour	Heat (kalories) dissipated per square metre of surface per hour.
Severe cases of diabetes	1·40 ...	... 40·21
Mild cases	1·21 ...	... 38·83
All cases	1·33 ...	... 39·76
All normal persons	1·21 ...	... 39·96

J. S. MACDONALD.

THE ICE AGE IN CORSICA.[1]

DR. LUCERNA has made an elaborate study of the physiography of the mountains which occupy so large a part of Corsica, and culminate about 2700 m. above sea-level. Brought up, evidently, at the feet of Prof. Brückner, he has no difficulty in recognising the pre-glacial valley floors and the successive deepenings due to the advancing glaciers of the Günz, Mindel, Riss, and Würm times. The existing moraines, of course, chiefly belong to the last of these, and he is able to identify, as has been done in the Alps, the Bühl, Gschnitz and Daun stages of retreat. The height of the snow-line appears to have varied with the locality, but was generally rather lower than in the southern parts of the Maritime Alps; in more than one place it was about 1650 m., which would signify a sea-level temperature nearly 17° F. lower than that of Ajaccio at the present day. In the valleys, terminal moraines occur, these, of course, being at various levels; for example, in one case at 1350 m., in another as low as 750 m.

As the deepening of the valleys, according to Dr. Lucerna, was a feature hardly less notable than in the Alps—in one valley it amounted, during the Mindel and Riss episodes only, to as much as 85 m.—the advances of the ice gave rise to great masses of gravel, forming terraces in the lower districts, each of which the author assigns to its proper date. Nothing could be more complete. But perhaps some sceptics will suggest that though a cliff terrace on a valley flank indicates, not only a deepening, but also some change in the conditions of erosion, it does not prove a glacier to have been the agent, and that in Corsica, as in the Alps, very much that is set down to the work of ice may quite as well have been pre-glacial.

The second part of Dr. Lucerna's memoir discusses the sea-level in Corsica. During the Glacial epoch the island was gradually rising, and a raised beach or terrace corresponds with each of its episodes. The Günz terrace, near Ajaccio, is about 70 m. above sea-level, the Mindel nearly 40 m., the Riss about 27 m., and the Würm perhaps 13 m. Even the Bühl level can be detected still nearer the sea. The coincidences are curious, but space does not permit an enumeration of the facts from which the conclusions are drawn. If they do not always convince the reader, they will, at any rate, prove that Dr. Lucerna's memoir is a most laborious study of Corsican physiography.

[1] Dr. Roman Lucerna: "Die Eiszeit auf Korsika und das Verhalten der exogenen Naturkräfte seit dem Ende der Diluvialzeit" (Abhandlungen der k.k. Geographischen Gesellschaft in Wien. ix. Band, 1910, No. 1). Pp. vi+144+xiii plates. (Wien: R. Lechner, 1910).

THE PROGRESSIVE DISCLOSURE OF THE ENTIRE ATMOSPHERE OF THE SUN.[1]

Révélations de la couche supérieure de l'hydrogène.

L'ANNÉE suivante, en 1909, nous avons, d'Azambuja et moi, étudié avec les mêmes appareils les raies de l'hydrogène et surtout la raie rouge H_α. Ces raies ont été isolées déjà avec le spectrohéliographe par Hale et Ellermann, qui ont obtenu des résultats fort curieux. En 1903 ils ont reconnu que, avec H_β, H_γ, H_δ, les plages faculaires ne sont plus brillantes par rapport au fond, comme avec le calcium, mais sont souvent noires au contraire. Avec H_α, isolé en 1908, on a en plus tout autour des taches des séries de petites lignes, qui donnent parfois l'impression nette d'un tourbillon, et que Hale a décrites ici même dans une conférence spéciale. De plus ces images de H_α sont magnifiques et très riches en fins détails.

Cependant ces images américaines de H_α sont obtenues par l'isolement de la raie entière, et j'ai annoncé en 1908 qu'elles devaient être un mélange de deux ou trois images et couches distinctes. En effet, d'après Rowland, la raie H_α est doublement renversée, comme la raie K du calcium, mais plus faiblement. Sa largeur avec les parties dégradées est $1^{A}24$, et $0^{A}90$ sans ces mêmes parties. Il faut donc s'attendre à des images quelque peu différentes, lorsqu'on isole les différentes parties de la raie.

Or nous avons vérifié nettement ce fait, et même, contrairement à notre attente, les différences entre les images de l'hydrogène sont relativement plus grandes qu'avec le calcium.

Les résultats exacts sont les suivants :—

Si on isole avec H_α la partie dégradée près des bords, qui correspond à K_1 du calcium à une distance du centre comprise entre $\frac{37}{100}$ et $\frac{62}{100}$ d'Angström, on a le résultat de 1903, c'est-à-dire les plages faculaires noires par rapport au fond.

Avec le milieu de chaque moitié, entre les distances $\frac{16}{100}$ et $\frac{42}{100}$ d'Angström, l'image est toute différente ; elle offre les principaux caractères des images américaines de 1908, et en particulier les groupements de petites lignes qui constituent ce que Hale a appelé les *Solar Vortices.*

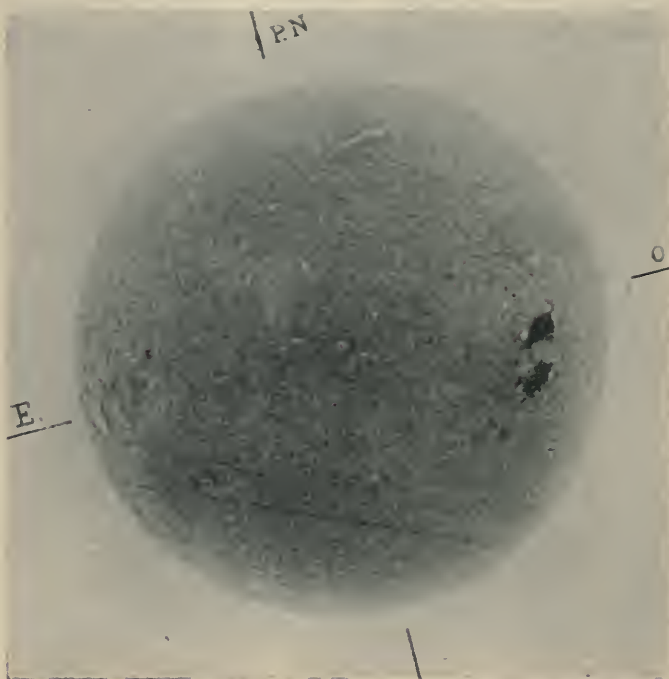
Enfin, avec le centre de la raie, on a une troisième image différente des deux autres, beaucoup plus pâle et simple, qui correspond à la couche supérieure de l'hydrogène.

Or, et *ce point est important*, cette *nouvelle* image offre les mêmes filaments noirs que la couche K_3 du calcium. Quant aux plages faculaires, sur cette image, elles ne sont jamais noires mais brillantes ; elles sont moins étendues qu'avec K_3, et correspondent aux maxima de lumière de ces mêmes plages dans la couche K_3, maxima qui diffèrent de ceux des couches K_2 et K_1. Les parties les plus noires et les parties les plus brillantes sont les mêmes. (Voir les images conjuguées de K_3 et de H_α, obtenues le 11 septembre 1909, les 21 mars et 11 avril 1910.)

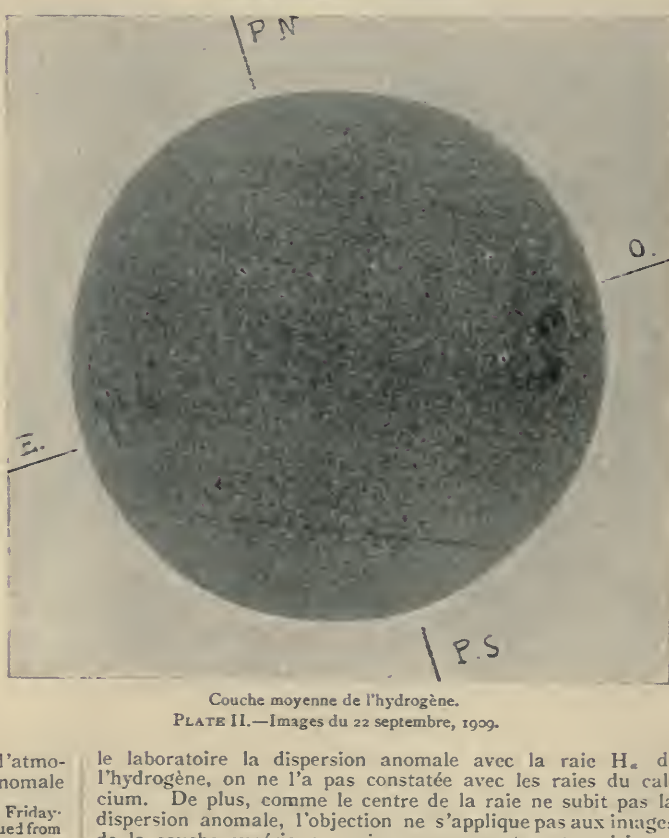
De plus nous avons isolé aussi les différentes parties de la raie bleue H_δ de l'hydrogène, moins élevée dans l'atmosphère que la raie H_α et nous avons obtenu des images qui montrent presque exclusivement les plages faculaires en noir, comme la partie dégradée de la raie rouge H_α, et qui correspondent donc à une couche basse.

Finalement, on est conduit à conclure que l'hydrogène offre, comme le calcium, au moins trois couches distinctes superposées, qui sont pour la première fois clairement séparées.

Cependant, dans ce qui précède, j'ai expliqué les différentes parties d'une même raie, et les différentes images par le jeu ordinaire de l'émission et de l'absorption dans les gaz, en admettant, comme il est naturel, que la densité du gaz et la largeur de la raie diminuent lorsqu'on s'élève dans l'atmosphère. Mais on a objecté que la dispersion anomale pouvait jouer aussi un rôle et expliquer au moins en partie les particularités des images. Or, à mon avis, la dispersion anomale, certes, doit intervenir, mais faiblement, et est négligéable dans une première étude. Les raisons sérieuses à l'appui de cette assertion, seraient ici trop longues à développer. D'ailleurs si on a reconnu dans



Couche supérieure de l'hydrogène.

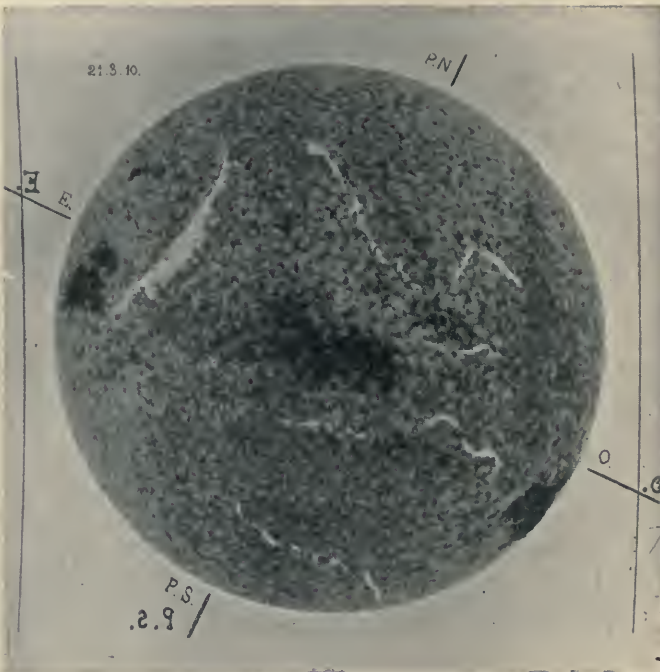


Couche moyenne de l'hydrogène.
PLATE II.—Images du 22 septembre, 1909.

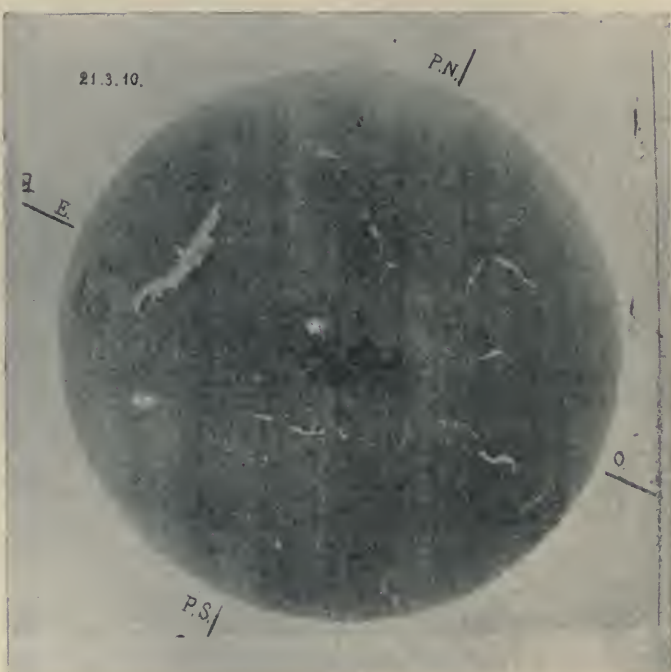
le laboratoire la dispersion anomale avec la raie H_α de l'hydrogène, on ne l'a pas constatée avec les raies du calcium. De plus, comme le centre de la raie ne subit pas la dispersion anomale, l'objection ne s'applique pas aux images de la couche supérieure, qui nous occupent surtout ici.

[1] Discourse delivered at the Royal Institution of Great Britain, on Friday, June 12, 1910, by Dr. H. Deslandres, Membre de l'Institut. Continued from p. 426.

Les filaments noirs qui se retrouvent les mêmes avec le calcium et l'hydrogène, sont bien un élément caractéristique des couches supérieures. Quelques uns avaient été déjà entrevus ou signalés par Hale dans les premières images



Couche supérieure du calcium.



Couche supérieure de l'hydrogène mélangée à une petite portion de la couche moyenne.

PLATE III.—Images du 21 mars, 1910.

complexes de K et de H_α sous le nom de longs flocculi noirs, et présentés comme dûs très probablement aux couches élevées. On a en effet dans ces conditions les filaments les plus importants dont la raie noire est très large. En fait la reconnaissance complète des filaments et de leurs propriétés ne peut être abordée qu'avec les images mêmes des couches supérieures.

Un autre élément important de ces dernières couches est la plage faculaire brillante qui se retrouve au même point que sur la surface, mais avec des formes différentes.

En résumé, si on considère les quatre couches formées par la surface et l'atmosphère, les parties les plus brillantes restent au-dessus des facules. Mais les parties les plus noires ont des positions très différentes sur la surface et dans la couche supérieure. En bas ce sont les taches et en haut ce sont les filaments, qui ont une surface noire totale supérieure à celle des taches. Il convient de mesurer l'aire des filaments aussi exactement que celle des taches.

Recherches sur les mouvements de l'atmosphère. Spectro-enregistreurs des vitesses.

Le filament noir attire surtout l'attention, et a bien, comme il a été dit plus haut, une importance au moins égale à celle des taches. Quelle est donc l'origine, quelle est donc la nature de ces longues lignes noires? Une réponse précise est bien difficile, et il suffit de rappeler notre incertitude à l'égard des taches qui sont étudiées depuis 300 ans. Cependant avec le filament, la recherche peut être plus facile. La surface, qui porte la tache, est comprise entre l'intérieur du soleil, qui nous échappe et les couches basses complexes de l'atmosphère; mais la couche supérieure, à laquelle est lié le filament, est plus libre, plus dégagée, et peut avoir une structure et des mouvements plus simples.

Et en effet, nous avons obtenu récemment à Meudon sur le filament quelques résultats dignes d'intérêt et grâce à l'emploi d'un appareil spécial, organisé jusqu'ici à Meudon seulement et appelé *Spectro-enregistreur des vitesses.* Cet appareil que j'emploie depuis 1892, a été en 1907 largement amélioré. Il décèle, comme son nom l'indique, les mouvements radiaux des vapeurs solaires, en juxtaposant les petits spectres de sections successives équidistantes sur le disque solaire, avec une seconde fente large et des mouvements discontinus automatiques. Cet enregistreur est un complément obligé du spectrohéliographe et est au moins aussi utile. Il décèle, outre les vitesses radiales, les formes générales de la vapeur, les détails de la raie entière et en particulier la largeur de la raie isolée, largeur très variable d'un point à l'autre de l'astre. Il révèle les points où le spectrohéliographe est en défaut; car ce dernier ne peut, avec une fente de largeur constante, isoler exactement une raie de largeur variable; en un mot il enregistre tous les éléments qui échappent au spectrohéliographe et permet d'interpréter sûrement ses résultats.

Sur les épreuves obtenues avec la raie K, l'examen à l'œil nu montre aussitôt que les mouvements radiaux sont en général plus notables sur le filament que sur les points voisins; parfois même toutes les raies K_3 du filament sont inclinées dans le même sens; ce qui annonce un tourbillon à axe horizontal, qui peut être opposé au tourbillon à axe vertical admis dans les taches. Mais, à cette agitation succède, comme avec la tache, un calme relatif. Si alors, on mesure avec soin les déplacements et la vitesse radiale de K_3 lorsque la vapeur est au centre du soleil, on trouve que la vapeur est ascendante et avec une vitesse souvent supérieure à la vitesse équatoriale de rotation (soit 2 km. par seconde). Le fait a été vérifié sur plusieurs filaments. Les taches et les filaments mis à part, les vitesses verticales dans la couche supérieure sont notables et souvent du même ordre que la vitesse équatoriale de rotation. La grandeur de ce mouvement vertical étonne moins si on remarque que la masse de gaz qui est l'atmosphère repose sur un foyer intense de chaleur.

Des mesures analogues ont été faites avec soin au centre

du soleil sur les facules et les flocculi, et le résultat a été inverse. La vapeur, au contraire, a un mouvement descendant et les parties relativement noires autour sont ascendantes. D'une manière générale aux points brillants de l'image K_3 de la couche supérieure, la vapeur descend; elle monte là où l'image est relativement sombre; ce qui est assez logique, car la vapeur qui descend se comprime et s'échauffe; celle qui monte se détend et se refroidit.

Cette propriété reconnue déjà sur un grand nombre d'épreuves est importante; car elle explique la structure spéciale de ces couches atmosphériques, qui s'annoncent comme divisées en courants de convection juxtaposés, exactement comme les liquides de nos laboratoires chauffés uniformément par le bas.

Les flocculi brillants forment souvent sur une étendue notable et avec netteté des polygones juxtaposés par leurs sommets, et tout semblables aux polygones qui constituent les cellules tourbillons des liquides, si bien étudiées en France par Besnard.[1] Comme la vapeur descend sur les flocculi brillants et s'élève dans des intervalles, chaque polygone solaire est aussi une cellule tourbillon. Quant aux autres flocculi du même soleil ils offrent des polygones moins nets ou incomplets, ou encore, mais plus rarement, ont des formes tout à fait irrégulières.

D'autre part, les filaments et alignements sont probablement la limite de tourbillons cellulaires plus grands, superposés aux précédents dans la couche supérieure, et dont les taches occuperaient le centre. Cette disposition est en accord avec les mouvements de cette couche près des taches reconnus par l'astronome anglais Evershed. On s'explique alors aisément pourquoi les taches sont des points et les filaments des lignes parfois très longues. La question, par ces recherches, est donc déjà un peu éclaircie; elle sera, semble-t-il, élucidée complètement par des mesures continues de vitesses radiales, mesures étendues au disque entier de l'astre, et malheureusement très longues.

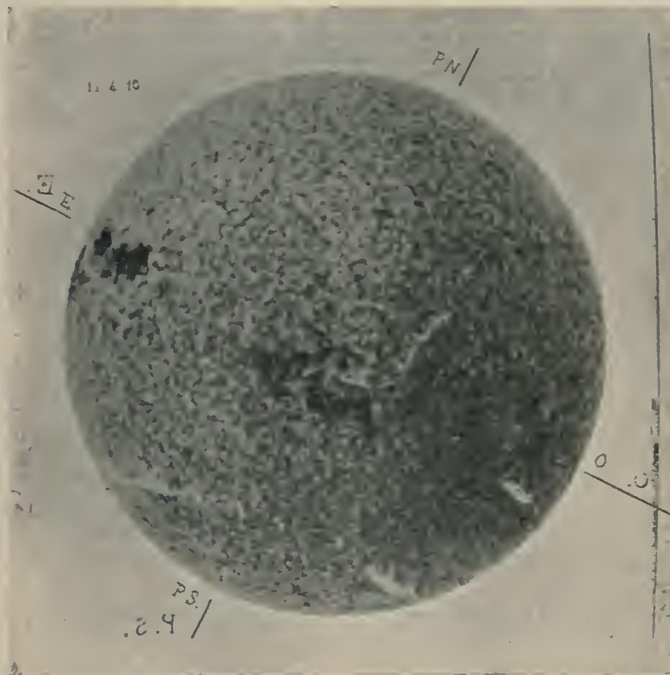
Reconnaissance des filaments polaires.

Je terminerai par une nouvelle propriété des filaments récemment reconnue à Meudon et publiée. L'observatoire a déjà les images de la couche supérieure pour plus de 20 rotations entières de l'astre, et il est possible d'étudier la distribution des filaments. Ils apparaissent à toutes les latitudes; mais, aux pôles, en général, ils sont groupés sur une courbe plus ou moins circulaire, souvent non confondue avec un parallèle, et qui entoure le pôle. Cette courbe polaire de filaments est parfois nettement dessinée au deux pôles; mais en général elle est nette seulement à un seul, et se déplace d'un pôle à l'autre. Cette courbe polaire était particulièrement nette et forte en avril dernier au pôle sud. (Voir les deux images du 11 avril et la Fig. 4, qui représente les filaments de quatre jours différents.)

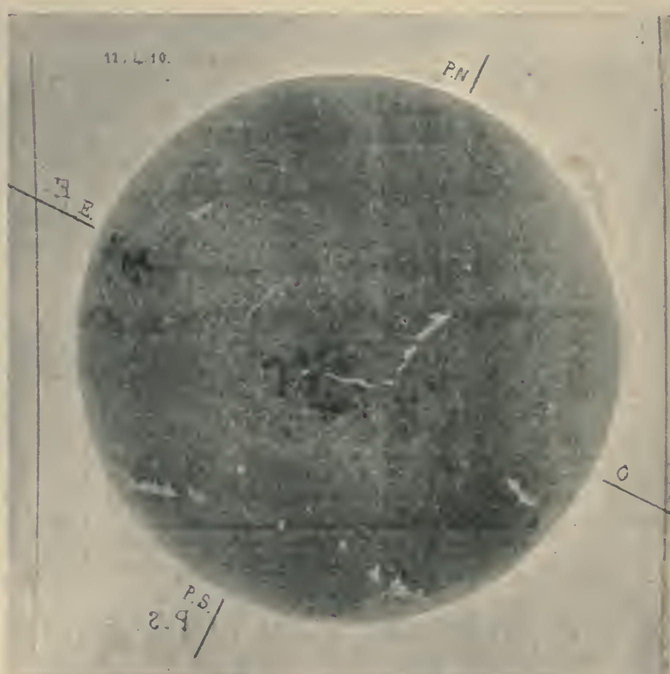
Ces filaments polaires sont accompagnés de proéminences, et sont en accord avec les maxima secondaires de proéminences qui ont déjà été signalées aux pôles. Ils peuvent aussi être en relations avec la forme particulière de la couronne solaire au moment du minimum et avec l'inclinaison souvent constatée de l'axe coronal par rapport à l'axe ordinaire de rotation.

Parfois, la courbe polaire est accompagnée du côté de l'équateur d'une ligne de filaments parallèles, qui est réunie à la courbe par des filaments ou alignements inclinés; et on a ainsi une disposition analogue à celle des bandes de la planète Jupiter.

Enfin la zone polaire de filaments, où la vapeur, comme on l'a vu plus haut, est ascendante, peut être rapprochée de la zone des taches et facules voisine de l'équateur, et où la vapeur est au contraire descendante. On est conduit à supposer dans la couche supérieure une grande circulation méridienne, un grand courant général de convection, analogue à celui qui existe



Couche supérieure du calcium.



Couche supérieure de l'hydrogène mélangée à une petite partie de la couche moyenne.
PLATE IV.—Images du 11 avril, 1910.

sur la terre dans chaque hémisphère entre la latitude de 35° et le pôle.

Le temps manque malheureusement pour développer toutes les conséquences de ces premières observations.

[1] Cette disposition par polygones juxtaposés est parfois très nette sur le Soleil presque entier. L'épreuve K_3 du 18 Septembre, 1908, présente dans l'hémisphère sud, près du centre, quelques-uns de ces polygones, réunis par leurs côtés et leurs sommets; mais, une image plus nette et plus grande est nécessaire pour les bien voir.

Mais les faits présentés suffisent à montrer le grand intérêt des études sur l'atmosphère solaire supérieure et la nécessité de les continuer.

L'atmosphère solaire est la seule que nous puissions observer dans son ensemble et dans ses couches successives. Nos appareils enregistreurs donnent en quelques minutes son aspect général et ses mouvements principaux ; à ce point de vue, elle nous est mieux connue que l'atmosphère terrestre que nous observons seulement dans ses parties basses et sur une étendue restreinte, même avec l'aide du télégraphe.

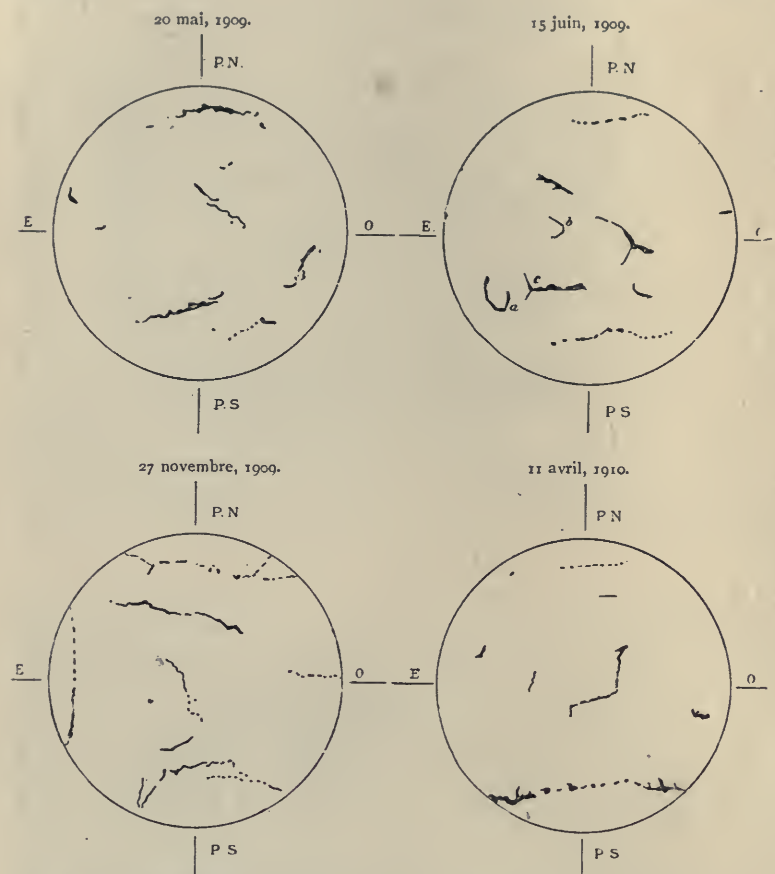


FIG. 4.—Images de la couche supérieure de l'atmosphère solaire qui montrent les filaments noirs caractéristiques et en particulier les filaments polaires. Ces images, obtenues avec l'aide de d'Azambuja, ont été relevées sur les épreuves monochromatiques du soleil obtenues avec la partie centrale des raies H_α de l'hydrogène ou K du calcium. Elles montrent seulement les filaments noirs sans les alignements. Les plages brillantes des épreuves au-dessus des facules n'ont pas été représentées.

Le réseau de courants de convection et les filaments curieux reconnus dans les couches hautes du soleil, peuvent se retrouver aussi sur la terre, et c'est ainsi que l'étude du soleil peut nous apprendre à mieux connaître notre propre atmosphère.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Adams prize for 1911 is awarded to Prof. A. E. H. Love, F.R.S., formerly fellow of St. John's College, for his essay entitled "Some Problems of Geodynamics."

The adjudicators of the Hopkins prize awarded by the Philosophical Society for the period 1900–3 have awarded the prize to Prof. J. H. Poynting, F.R.S., for his researches on the transmission of energy in the electric field and on the pressure exerted by radiation.

MR. FRANK HOWSON has resigned the lectureship in physiology in the College of Medicine of the University of Durham to accept a similar appointment at Sydney, New South Wales.

DR. T. J. MACNAMARA, M.P., Parliamentary Secretary to the Admiralty, will distribute the awards of prizes and certificates at the Battersea Polytechnic, and deliver an address, on Tuesday evening, February 28.

MR. JAMES LEES, assistant lecturer in the faculty of engineering at the University of Bristol, has been appointed to the post of lecturer in engineering in the South African College, Cape Town.

THE annual distribution of prizes to students of the City and Guilds of London Institute will be held on February 17 at the Mansion House, the Lord Mayor presiding. Dr. R. T. Glazebrook, F.R.S., of the National Physical Laboratory, will deliver an address.

IT is announced in *Science* that the fund of 150,000*l.* for the Johns Hopkins University is now complete. This insures the payment to the fund of a further 50,000*l.* offered conditionally in February of last year by the General Education Board, as was explained in our note last week on the report of the president of the Johns Hopkins University for the year ended August 31, 1910.

DR. HERMON C. BUMPUS has resigned the post of director of the American Museum of Natural History, New York, which he has held since 1902, and has accepted an appointment as "business manager" of the University of Wisconsin. The post is a new one, the University having recently decided to divide the administrative work between the president and an officer of this name. The office will be entirely separate from academic or teaching functions.

THE Drapers' Company has made a grant of 15,000*l.* for the erection of a new wing for the department of applied science of the University of Sheffield. The new buildings will be used to house the mining section and the research department for the silver and allied trades. The council of the University on January 27 passed a resolution thanking the Drapers' Company, and expressed a desire to associate the name of the Drapers' Company with the extensions as a record of the company's generosity.

THE Birmingham Education Committee has decided to recommend the City Council to increase the grant to the University of Birmingham from one halfpenny in the pound to an amount equal to one penny in the pound on the assessable value of the city, which it is expected will amount to about 12,000*l.* The Education Committee has agreed also to suggest to the University authorities the need for increasing the number of scholarships available for persons who would not otherwise be able to take advantage of the University teaching.

THE following gifts and bequests for higher education in the United States have been announced recently in *Science*. An old student, who does not wish his name disclosed, has given 20,000*l.* to the University of Pennsylvania for the endowment of a chair of physiological chemistry. It will be known as the "Benjamin Rush chair of physiological chemistry." Dr. Alonzo E. Taylor, formerly of the University of California, will be the first occupant of the chair. The University of Vermont has received 13,593*l.* from the Rockefeller Foundation, repre-

senting the first instalment of a gift of 20,000*l.* made to the University on condition that an additional 80,000*l.* was raised. The 80,000*l.* has now been subscribed, and the amount 54,200*l.* has been collected. The total amount is to be added to the endowment fund for the general uses of the University. Mr. William Blodgett has given to Columbia University two farms near Fishkill, N.Y., to be used in connection with the work in agriculture. By the will of Mrs. Martin Kellogg, Yale University receives a bequest of 10,000*l.* from the estate of the late Mr. Martin Kellogg, who was formerly president of the University of California.

LORD CURZON OF KEDLESTON was on January 25 installed as Lord Rector of Glasgow University. The subject of his address was "East and West: a Retrospect and a Forecast." After a brilliant review of the ethnographic and historic *differentiae* of Asia and Europe, he proceeded to estimate the probabilities as to their future relations. Some had argued that we in Europe "have given to Asia little that she values, or, if left to herself, would not cast away. Our education, it is said, she has only borrowed to turn against us; our religion she rejects; our civilisation she despises; she is indifferent to our science; she will manufacture our implements for her own protection; she will dispute our hegemony, defy our authority, dispense with our agents, undersell our produce, and end by annexing our trade." Lord Curzon gave in detail his reasons for disbelieving this prediction. Among others, he recalled the fact that "the inventions of science, which we are told that the East is to retain for its own selfish use, are not confined to producing the comforts, or conveniences, or even the destructive implements that are employed by man. They have, on the whole, a unifying and softening influence. The electric telegraph, the railway, the steamship, the Press, the post, travel to and fro—all these are agencies which tend to bring men together rather than keep them apart. Medical science has shown itself to be so valuable an instrument of social influence and fusion, that it has been permanently grafted on to missionary enterprise. The common share in this heritage of science would render it very difficult for the East to shut itself successfully off again from the West, or to pursue a policy of selfish exclusion. Even were the dependent portions of the East to recover complete political autonomy, the Western would be always "within its gates." "Some of those whom I have the honour of addressing here may be called on to play a part in the future evolution of the great drama which I have endeavoured to describe. If so, I would ask them to bear in mind three things—never to look down on the East or the Eastern; to remember that the progressive elevation of the East is still the noblest work with which the West is charged; and to realise that each individual European in Asia is not merely a soldier, but a standard-bearer of his race. In a Chinese temple at Canton there stands a venerated gilt statue of a man with a benevolent expression on his features and a black hat on his head. He is supposed to be the Venetian Marco Polo, and to be thus honoured by the Chinese because he taught the West to understand and to respect the East. Be it yours, if you have the opportunity, to earn a similar reputation."

A CONFERENCE of about forty delegates of the provincial joint committees of European schools in India was held early in January at Calcutta, under the presidency of Sir Robert Laidlaw. In addition to delegates from every province in India, including Burma, we learn from the *Pioneer Mail* that several prominent education officials were present and took part in the discussions. Several speakers pointed out the inadequacy of the educational facilities offered for the children of Europeans in India, and eventually some fifteen resolutions were adopted. One resolution urged that in view of the great and increasing difficulty of finding suitable occupations for the children of the domiciled community, as well as for other and higher reasons, this conference regards it as urgently necessary that European schools should be enabled to provide a more efficient and complete training, physical and intellectual, than they have hitherto given, and that to such improved general education should be added instruction especially devised to prepare scholars for their chosen professions in life. Another recorded that the conference regards a more efficient staff, especially in the lower classes of schools, as an indispensable condition of improvement in education. Whilst considering it necessary that for the present qualified teachers should, as hitherto, be brought from abroad, the conference regards it as equally necessary that such efficient training should be provided in India as should make it possible for locally recruited candidates to equip themselves fully for the teaching profession, and, further, the conference considers "that every qualified teacher should enjoy a reasonable salary increasing with long service, some provision for retiring allowance, and fair security of tenure." A third resolution pointed out that the conference regards the adequate and complete education of the domiciled community as one of the primary responsibilities of the Government of India, and considers that in view of the necessary larger cost of that education the imperial revenue must bear a larger share than heretofore. At the same time, it acknowledges the duty both of the Christian churches and the domiciled community to assist the Government financially and otherwise to a much greater extent than in the past. Regarding the curricula of Indian universities as unsuited to European students, the conference strongly urged the establishment of a Central European College affiliated to the University of London, and staffed, for the present, by fully equipped teachers from abroad. To this college, it was decided, may suitably be added classes for the training of secondary teachers.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 26.—Sir Archibald Geikie, K.C.B., president, in the chair.—Major P. A. **MacMahon**: Memoir on the theory of the partitions of numbers. Part v.: Partitions in two-dimensional space.—Arthur **Schuster**: The origin of magnetic storms. The paper contains a critical examination of the theory that magnetic storms are caused by streams of electrified corpuscles ejected from the sun. If the electro-kinetic energy of such storms be calculated, it is found that, when the magnetic field produced is comparable with that observed in magnetic storms, the energy is enormously great compared with that obtained by mere addition of the energies of the separate corpuscles. Even if during violent storms, when the magnetic force may be of the order 0·004 C.G.S., the corpuscles had an initial velocity nearly equal to that of light, the energy required to establish the magnetic field would be sufficient to reduce the speed to less than 4 kilometres a second before the swarm reaches the earth, the passage between the sun and the earth taking about a year. In this calculation the cross-section of the swarm is assumed to be determined by the effective duration of the magnetic disturbances which it is supposed to produce. If the swarm be reduced in cross-section the energy belonging to it would be diminished, but for a given magnetic force the density of the corpuscles in the swarm must then be correspondingly greater. This leads to the consideration of the effects of electrostatic repulsion between the particles. It appears that if H be the magnetic effect, the electrostatic acceleration at the edge of a swarm of electrons must be greater than 5×10^{17} H. This acceleration would be sufficient to drive a corpuscle in the first second through a distance equal to more than the diameter of the earth. It follows that, even taking account of electromagnetic attractions between the corpuscles, a swarm of corpuscles, when sent out from the sun in a definite direction, would soon be dissipated to such an extent that no sensible magnetic disturbance could be produced. Finally, the electrostatic effects, which would be observed on the surface of the earth in each magnetic storm, are discussed, and here the calculation also leads to the conclusion that the theory criticised is untenable. If magnetic disturbances are produced by rays emanating from the sun, it can therefore only be in an indirect manner. We may imagine that the injection of corpuscles ionises the upper portions of the earth's atmosphere, and consequently renders the already existing electromotive forces more effective, or we may imagine that the approach towards the earth's magnetic field of highly conducting

material containing ions of both kinds acts by induction. The effect of such induction would primarily be an increase in the horizontal and a diminution of the vertical forces, while the currents induced in the earth, tending to diminish the horizontal forces, would, owing to their inertia, die out more slowly, so that a semi-permanent effect would be left after the storm. This agrees with observation, but there are at present not enough data available to test the sufficiency of the explanation.—Arthur **Schuster**: The periodicity of sun-spots. In this communication, the sun-spot records of the last ten years are discussed in so far as they have a bearing on the results previously submitted to the society. It appears that the period of 4·79 years discovered by the author is confirmed, but that the evidence does not support the periodicity of 4·38 years, which had been previously described as doubtful, nor that of 8·36 years, which during the first half of last century seemed active. Attention is directed to the independent discovery of the period of 4·79 years in the declination range of the magnetic needle at Munich by Mr. Oppenheim.—Dr. G. C. **Simpson** and C. S. **Wright**: Atmospheric electricity over the ocean. This paper contains the results of observations made on the voyage from England to New Zealand on Captain Scott's Antarctic ship the *Terra Nova*. The investigation is divided into four parts. The first part deals with the electrical potential-gradient over the ocean. It is found that the gradient has its chief maximum in the evening and its chief minimum soon after midday. The afternoon minimum is remarkable because, though observed at many stations on land, it has often been ascribed to the disturbing effect of dust. In view of the present results, this explanation does not seem correct. The minimum, which is observed at 4 a.m., and which has been considered the principal one in observations taken on land, is only feebly developed at sea. The numerical value of the potential-gradient was found, on the average, to be about 80 volts per metre, and is therefore approximately the same as that observed on land. The second part of the investigation deals with the quantity of radio-active products which are found in the air. The observations show that these products are decidedly fewer at sea than on land, and a specially low value, both north and south of the equator, is found in latitudes from 30° to 40°. This is ascribed to the fact that the air in these latitudes is supplied by pure air descending from the upper parts of the atmosphere, while it is mainly the air which has passed over land which carries radio-active products with it. In the third part of the investigation, the number of free ions in the air are measured, and here again it is found that the ionisation over the sea is smaller than that over land. In the concluding part of the paper the spontaneous ionisation in a closed vessel is measured. Though part of the effect is ascribed to a real effect of air becoming conducting by itself, some of the results obtained indicate clearly that when the ship near land was exposed to radio-active emanation, the observed ionisation showed an increase for several hours afterwards.—Dr. W. H. **Young**: The Fourier constants of a function. In this paper the possibility of treating the Fourier series of a function $f(x)$ in various circumstances, as if it were convergent and integrable term by term, when multiplied by another function, is illustrated by the application of this fact to the determination of expressions for $\Sigma a_n n^{-q}$ and $\Sigma b_n n^{-q}$, a_n and b_n denoting the Fourier coefficients of $f(x)$, and q having a non-negative value. The formulæ are shown to be valid for any function that has bounded variation in an interval containing the origin, and is elsewhere summable, provided only that q is greater than zero.—J. A. **Crowther**: The energy and distribution of scattered Röntgen radiation. Experiments have been made to determine what fraction of the incident radiant energy is scattered per unit mass of a radiator when primary Röntgen rays fall upon it. From the numbers obtained a value has been deduced for the number of electrons per atom of the radiating substance. The value obtained agrees closely with that previously deduced from experiments on the scattering of homogeneous β rays, being very nearly three times the atomic weight of the substance. The distribution of the scattered radiation has been measured. It reaches a maximum forwards and backwards along the line of the primary beam, and falls to a minimum at right angles to this direction. At any given angle with the primary beam there is always a preponderance of scattered radiation in the forward direction. This preponderance increases the more nearly we approach the line of the primary beam.—Mrs. Hertha **Ayrton**: Some new facts connected with the motion of oscillating water. The author's explanation of the origin of ripple-forming vortices having been contested, she has made further experiments to prove the two propositions on which it rests, viz. that when water oscillates over a submerged obstacle:—(1) during the whole of any single swing a diminution of pressure is established close to the upper part of the lee side of the barrier; (2) while the water is falling below the mean level, in the half of the trough where the obstacle is, there is a back pressure against the flow on its lee side below the area of diminished pressure. Experimental proof of these pressure conditions is given by means of an obstacle in the form of a hollow watertight box, of which the top and one side are covered with thin guttapercha tissue diaphragms, the air being expelled and the box partly filled with water. These pressure conditions cause a jet to flow down close to the lee side of an obstacle during the first part of a swing, and a vortex to form during the second by upsetting the equilibrium of water, in the lee of the obstacle, that would otherwise remain at rest. The back pressure extends only to the limits of this slack water, *i.e.* to the line where the lowest water flowing over the obstacle strikes the bottom. A trough with an artificial end fitted with diaphragms is used to show that such pressure conditions are not confined to submerged obstacles, but come into existence close to any solid where water, in oscillating, is moving away from it, and wherever two masses of water are flowing away from one another, as at the node of a stationary wave. These variations of pressure give rise to jets and vortices near the surface of oscillating water wherever it meets the end of a vessel, and at every node; it is these jets and vortices, and the streams that feed them, that cause the residual whirls previously found by the author in oscillating water. The most important proof of this is that when the trough is rocked, so that there is much bottom motion but very little rise and fall, and, consequently, only feeble jets and vortices, the author's residual whirls are insignificant, while Lord Rayleigh's, beneath, develop to their full length and height even in deep water.

Geological Society, January 11.—Prof. W. W. Watts, F.R.S., president, in the chair.—Miss G. R. **Watney** and Miss E. G. **Welch**: The zonal classification of the Salopian rocks of Cautley and Ravenstonedale. The district described lies north-east of Sedbergh and west of the Dent fault. Below are Valentian rocks (A and B divisions of the Stockdale shales). The Wenlock beds are most fully developed in some streams entering the river Rawthey from the south. The detailed succession of these is given, and confirmatory sections are described in other parts of the district. The Ludlow beds are found mainly in the northern part of the area, where the geology is simpler. A comparison is instituted between these beds and those in the Welsh borderland, and those of Wenlock age in southern Sweden. A description of a Cyrtograptus intermediate in character between *C. rigidus* and *C. symmetricus*, and of a new Monograptus from the Nilssoni beds of Wandale Hill, is given in a palæontological section.—Herbert **Bolton**: A collection of insect remains from the South Wales Coalfield. Nine examples of insect remains, all, with one exception, blattoid in character. Seven are described as new species. The insect remains are referable to three horizons, one at the base of the upper series of the Coal Measures, and two in the upper part of the Pennant series. The suggestion is put forward that possibly Carboniferous cockroaches were not only phytophagous in habit, but frequented decaying Cordaites leaves in order to feed upon the Spirorbis. The presence of archimylacrid and orthomylacrid forms is considered indicative of an advance in insect development in the British Carboniferous beyond the palæodictyopteran types, while their abundance in the Pennant and upper series of the South Wales Coalfield may justify the hope of finding more primitive forms at a lower horizon in the same coalfield.

Royal Microscopical Society, January 18.—Prof. J. Arthur Thomson, president, in the chair.—Prof. J. Arthur **Thomson**: Presidential address: the determination of sex. The president discussed, historically and critically, five theories or sets of suggestions. (1) It has been suggested that environmental condition, operating on the sexually-undetermined, developing offspring-organism, may, at least, share in determining the sex. The evidence in support of this has in great part crumbled before criticism and before the counter-evidence of cytologists and Mendelians. (2) It has been suggested that the sex is quite unpredestined in the germ-cells before fertilisation, and that it is then settled by the relative condition of the gametes (as affected by age, vigour, &c.), or by a balancing of the inherited tendencies which these gametes bear, neither ovum nor spermatozoon being necessarily decisive. The evidence in support of this is very far from satisfactory. Yet in view of some sets of experiments, of R. Hertwig in particular, it seems rash to foreclose the question. (3) It has been suggested that the sex is predestined at a very early stage by the constitution of the germ-cells as such, there being female-producing and male-producing germ-cells, predetermined from the beginning, and arising independently of environmental influence. The evidence in support of this is very strong, both on experimental and on cytological grounds. (4) It has been suggested that maleness and femaleness are Mendelian characters, and one form of this very attractive theory is that femaleness is dominant over maleness, and that females are heterozygous as regards sex and males homozygous as regards sex. But there are grave difficulties as well as very striking corroborations. (5) It has been suggested that environmental and functional influences, operating through the parent (or, in short, the parent's acquired peculiarities), may alter the proportion of effective female-producing and male-producing germ-cells, as, for instance, in Russo's experiments on rabbits. This possibility remains tenable. Prof. Thomson argued in support of the thesis that there is no sex-determinant at all in the usual sense, but that what determines the sex of the offspring is a metabolism-rhythm, a relation between anabolism and katabolism, or a relation between the nucleoplasm and the cytoplasm. Many sets of facts converge in the inference that each sex-cell or gamete has a complete equipment of both masculine and feminine characters, of which there are doubtless chromosomic determinants. It may be that the liberating stimulus which calls the masculine or the feminine set into expression or development is afforded by the metabolism-rhythm set up in the cytoplasmic field of operations. It may be that this metabolism-relation—between nucleoplasm and cytoplasm doubtless, and likewise between anabolism and katabolism—leads, first and necessarily, to the establishment of ovaries or of spermaries, and secondly, either directly or through the gonads with their internal secretions, to the expression of the contrasted masculine or feminine characters.

PARIS.

Academy of Sciences, January 23.—M. Armand Gautier in the chair.—L. E. **Bertin**: Additional remarks on the general laws of retarded or accelerated motion in ships.—A. **Müntz** and E. **Lainé**: The nitrates in the atmosphere of the Antarctic regions. A series of determinations of the nitrates in snow and rain in southern latitudes have been carried out by R. E. Godfroy, accompanying Dr. Charcot's Antarctic expedition. Expressed in milligrams of nitric anhydride per litre, the amounts found varied between 0·1 and 0·4, with an average of 0·23. These results are compared with the data of Boussingault in Alsace, Lawes and Gilbert at Rothampstead, and Müntz and Marcano at Caracas, in the tropics. It was especially desired to obtain figures for the proportion of nitrate in rain and snow during the occurrence of the aurora borealis, but owing to the absence of this phenomenon at the stations occupied by the expedition, these data were not obtained.—M. Branly was elected a member in the section of physics in the place of the late M. Gernez.—Ernest **Esclangon**: A system of fixed or differential synchronisation. An improvement in the system of governing recording chronographs. The synchronising wheel, making approximately one revolution per second, carries two poles of soft iron, and these pass at each revolution in front of two electromagnets, the latter being actuated by the controlling clock. If the wheel carrying the electromagnets is slowly rotated, a differential movement is obtained. If driven so as to make one revolution in twenty-four hours, for which purpose an ordinary clock movement is sufficiently accurate, the synchronising wheel can be controlled to give one revolution per sidereal second. The system can also be applied with advantage to the control of an equatorial.—P. **Idrac**: First observations on the new star in Lacerta. The spectrum of this star, discovered December 30, 1910, has been studied and photographed at the Observatory of Meudon with the arrangement already used for the study of the Halley and Innes comets. Five hydrogen lines are brilliant, and also a strong band about $\lambda=464$. As regards the classification of this star, it might be either a variable star of long period or a new star; the great brilliance of the hydrogen lines appears to rather favour the second hypothesis.—C. **Russyan**: The system of generalised canonical ordinary differential equations and the generalised problem of S. Lie.—Paul **Lévy**: Differentials of functions of plane lines.—U. **Cisotti**: The dynamical reaction of a liquid jet. The dynamical reaction of the liquid jet does not depend on the form of the vessel in the neighbourhood of the orifice. In the particular case where the jet is a continuation of the axis of the vessel, the reaction of the liquid jet is entirely supported by the bottom of the vessel.—Jean **Becquerel**: The magnetic modifications of the absorption and phosphorescence bands of rubies, and on a fundamental question of magneto-optics. The nine different principal cases described by H. du Bois and Elias are shown to be reducible to five; the anomalies are shown to depend on a faulty orientation of the crystal with respect to the optic axes.—A. **Senouque**: Experiments in wireless telegraphy from an aëroplane. There is no difficulty in sending wireless messages from an aëroplane provided that the sending instruments are sufficiently strongly built to resist the disturbing influence of the vibrations of the motor, and are sufficiently light in proportion to the supporting power of the aëroplane.—Pierre **Weiss**: The rationality of the ratios of the magnetic moments of the atoms, and a new universal constituent of matter. By the assumption of the existence of a substance *magneton*, possessing a definite magnetic moment, the experimental results of Kamerlingh Onnes and Weiss, Weiss and Foëx, P. Pascal and other workers, are readily explained. Magneton is regarded as a universal constituent of matter.—C. E. **Guillaume**: The anomaly of the expansions of nickel-steels. The effect of chromium and manganese in altering the expansion of nickel-steels is discussed, and the results given in graphical form.—Eugène **Bloch**: The discharge potential in the magnetic field. The modern theory of disruptive discharge, in the few cases to which the calculation can be definitely applied, appears to be in complete accord with the observed facts. The rule of interkathodic action given by M. Gouy appears to fail in certain cases.—Jean **Meunier**: A new property of copper, and on the active flameless combustion of gases or convergent combustion.—J. **Bougault**: The transformation of phenyl-$\alpha\beta$-pentenic acid into its $\gamma\delta$-isomer. The action of solution of caustic soda on the $\alpha\beta$-acid did not give the expected $\beta\gamma$-isomer, but the $\gamma\delta$-isomer. The identity of the latter acid was established by its iodolactone and by the conversion of the lactone into the corresponding phenyl-$\gamma\delta$-pentenic acid. This is the first example of such a transformation.—Georges **Dupont**: Acetylene pinacone. This substance was prepared by the action of acetone on the magnesium compound of dibromoacetylene, and a description is given of its behaviour towards dehydrating agents and towards the halogen acids.—Pierre **Breteau**: A method for the complete destruction of organic matter in the detection and estimation of mineral poisons. The material is heated with strong sulphuric acid, as in a nitrogen determination, in a current of nitrous fumes. The oxides of nitrogen are obtained by the action of sulphur dioxide upon nitric acid. If the sulphur dioxide is taken from a cylinder of the liquid gas, the production of the oxides of nitrogen is under perfect control; 300 grams of organic matter can be completely destroyed in four hours by this method.—O. **Lignier** and A. **Tison**: Are the Gnetales apetalous

Angiosperms? It is concluded that the flowers of Gnetales are clearly Angiosperms, but, contrary to the views usually held, represent organs in course of reduction.—Marcel **Mirande**: The action upon green plants of some substances extracted from coal-tar and employed in agriculture. Various mixtures are sold of substances extracted from coal-tar for use as insecticides or antiseptics. It is shown that discretion must be employed in the use of such substances, as under certain conditions they may be harmful to plants.—René **Maire** and Adrien **Tison**: Some Plasmodiophoraceæ.—Eugène **Pittard**: An analysis and comparison of the dimensions of the skull and face in gipsies of both sexes.—Ch. **Gravier**: Some animals parasitic on the Madrepores of the genus Galaxea.—L. **Bordas**: The morphology and histological structure of the digestive apparatus of the larva of the Lepidoptera.—Paul **Marchal**: The parasites of the olive-fly in Tunis. A description of *Opius concolor*, a parasite of the olive-fly, and the part it may play in destroying this fly, and thus indirectly protecting the olive crop.—R. **Robinson**: The aponeurotic cavities of the intercostal muscles and their signification in physiology and medicine.—Ch. **Vaillant**: A new method of determining by radiography whether an infant, supposed to have been born dead, has really lived or not. After replying to various criticisms, the author adduces additional facts in support of the views put forward by him on this subject in 1908.—Marc **Romieu**: Plasmatic reduction in the spermatogenesis of *Ascaris megalocephala*.—Gabriel **Bertrand** and M. **Javillier**: The influence of manganese on the development of *Aspergillus niger*. Salts of manganese are shown to possess a markedly favourable influence on the development of this mould.—L. **Bounoure**: A comparative study of four digestive diastases found in some species of Coleoptera.—M. **Groth**: The primary of Sierra Morena.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part v. for 1910, contains the following memoirs communicated to the society:—

July 9.—K. Willy **Wagner**: The propagation of currents in cables with an imperfect dielectric.

July 23.—H. **Weyl**: Ordinary linear differential equations with singular regions and their proper functions.—L. **Lichtenstein**: The integration of a definite integral with respect to a parameter.—K. **Lerp**: The sources of error in the Kaufmann-Simon method of determining the specific charge of an electron.—F. **Bernstein**: The last of Fermat's theorems.—O. **Toeplitz**: The theory of quadratic forms with an infinite number of variables.—F. **Bernstein**: The second case of the last of Fermat's theorems.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 2.

ROYAL SOCIETY, at 4.30.—Experiments to investigate the Infectivity of *Glossina palpalis* Fed on Sleeping Sickness Patients under Treatment: Col. Sir D. Bruce, F.R.S., Captains A. E. Hamerton and H. R. Bateman, and Dr. R. van Someren.—Experiments to Ascertain if *Trypanosoma gambiense* during its Development within *Glossina palpalis* is infective: Col. Sir D. Bruce, F.R.S., and Captains A. E. Hamerton, H. R. Bateman, and F. P. Mackie.—Further Experimental Researches on the Etiology of Endemic Goitre: Captain R. McCarrison.—On the Leaves of Calamites (Calamocladus Section): H. Hamshaw Thomas.—Complement Deviation in Mouse Carcinoma: Dr. J. O. Wakelin Barratt.

ROYAL INSTITUTION, at 3.—Recent Progress in Astronomy: F. W. Dyson, F.R.S., Astronomer Royal.

LINNEAN SOCIETY, at 8.

RÖNTGEN SOCIETY, at 8.15.—The Work of Action of an Induction Coil: Prof. Salomonson.

FRIDAY, FEBRUARY 3.

ROYAL INSTITUTION, at 9.—Grouse Disease: A. E. Shipley, F.R.S.

GEOLOGISTS' ASSOCIATION, at 7.30.—Annual General Meeting.—President's Address: Flint and Chart: W. Hill.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Rivers and Estuaries: W. H. Hunter.

MONDAY, FEBRUARY 6.

ROYAL SOCIETY OF ARTS, at 8.—Brewing and Modern Science: Prof. Adrian J. Brown.

ARISTOTELIAN SOCIETY, at 8.—Value and Reality: Miss H. D. Oakeley.

SOCIETY OF CHEMICAL INDUSTRY, at 8 (at King's College). — The Chemistry of the Lead Chamber Process: Dr. F. Raschig.

SOCIETY OF ENGINEERS, at 7.30.—Presidential Address: F. G. Bloyd.

TUESDAY, FEBRUARY 7.

ROYAL INSTITUTION, at 3.—Heredity: Prof. F. W. Mott, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Recent Theories about Palæolithic Man: J. Gray.

ZOOLOGICAL SOCIETY, at 8.30.—On the Structure and Function of the Gas-glands and Retia Mirabilia associated with the Gas-bladder of some Teleostean Fishes, with Notes on the Teleost Pancreas: Dr. W. N. F. Woodland.—Skulls of Oxen from the Roman Military Station at Newstead, Melrose: Prof. J. Cossar Ewart, F.R.S.—Plankton from Christmas Island, Indian Ocean. I. On Copepoda of the Family Corycæidæ: George P. Farran.—On some New Zealand Spiders: H. R. Hogg.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Detroit River Tunnel, between Detroit, Michigan, and Windsor, Canada: W. J. Wilgus.

WEDNESDAY, FEBRUARY 8.

ROYAL SOCIETY OF ARTS, at 8.—Some Nigerian Head-hunters: Captain A. J. N. Tremearne.

GEOLOGICAL SOCIETY, at 8.—Investigations pursued in conjunction with Mr. R. E. Priestley, in the Course of the British Antarctic Expedition of 1907–09, more especially the Investigations connected with Glacial Geology: Prof. T. W. Edgeworth David, C.M.G., F.R.S.

THURSDAY, FEBRUARY 9.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: (1) Certain Physical and Physiological Properties of Stovaine and its Homologues; (2) The Effect of some Local Anæsthetics on Nerve: Dr. V. H. Veley, F.R.S., and W. L. Symes.—(1) Experimental Researches on Vegetable Assimilation and Respiration. VIII. A New Method for Estimating the Gaseous Exchanges of Submerged Plants; (2) Experimental Researches on Vegetable Assimilation and Respiration. IX. On Assimilation in Submerged Water-plants and its Relation to the Concentration of Carbon Dioxide and other Factors: Dr. F. F. Blackman, F.R.S., and A. M. Smith.

ROYAL SOCIETY OF ARTS, at 4.30.—Indian Superstitions: R. A. Leslie Moore.

ROYAL INSTITUTION, at 3.—Problems of Animals in Captivity: P. Chalmers Mitchell, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Adjourned discussion*: Long Distance Transmission of Electrical Energy: W. T. Taylor.—Extra High Pressure Transmission Lines: R. Borlase Matthews and C. T. Wilkinson.

MATHEMATICAL SOCIETY, at 5.30.—The Application of the Mathematical Theory of Relativity to the Electron Theory of Matter: E. Cunningham.

FRIDAY, FEBRUARY 10.

ROYAL INSTITUTION, at 9.—Robert Louis Stevenson: Sir Sidney Colvin.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Rivers and Estuaries: W. H. Hunter.

CONTENTS.

THURSDAY, FEBRUARY 9, 1911.

STUDIES IN PHYSIOLOGY.

Physiology the Servant of Medicine, being the Hitchcock Lectures for 1909, *delivered at the University of California, Berkeley, Cal.* By Dr. Augustus D. Waller, F.R.S. Pp. viii+143. (London: University of London Press and Hodder and Stoughton, 1910.) Price 5s.

WHATEVER may be the place of lectures in the education of youth, the endowments of lectureships for occasional addresses by distinguished men have proved of eminent service. And this not in science only, as the Gifford, Bampton, and other lectures bear witness. Of such happy advantage this bright little book is one more instance. Such an invitation serves both as a stimulant and a purpose to a man of science or learning, in the phrase of Prof. Waller (p. 66), to bring to "a kind of nodal point, or focus, several lines of thought"; and, moreover, to set forth for the intelligent world some summary of a life's impressions, which otherwise he might never have been led to do; and, as should be in such a work, this set of lectures contains matter of both practical and of theoretical value—matter, that is of both immediate and of future service to mankind.

Many of us in times past have wasted some little sympathy—quite uncalled for—with ardent physiologists, such as the late Burdon-Sanderson and our present author, who, in spite of laborious work in the field of electric biology, did not for a time seem to be engaged on a very remunerative task. In the field of therapeutics, for example, electric work seemed—apart from certain points or diagnosis—not to come to very much. But no one can read these lectures without being reinforced in the better judgment that if the harvest seemed long in coming it is now full of reward; and this little book, by a master of the subject, shows us lucidly and in perspective the useful and interesting results which are being attained. In the first lecture we read, from the starting point of the isolated muscle, the effects of ether, alcohol, and chloroform, in the electrical language of the cardiac muscle, as illustrated in part by the "torture" of "Jemmy." The point of view of this chapter is to illustrate how chemical changes in living tissues are signified and can be measured by the electrical. Lecture ii., starting from the isolated nerve, reads the language of nervous matter in the same manifestation. Lecture iii. is pharmaceutical, with a notable discussion of anæsthetics. Lecture iv. is full of facts and arguments on the photo-electrical response, not of the retina only, but also of green leaves and animal and vegetable tissues generally. The breadth of view, and this evocation of answers from all sides of nature, speak eloquently of the various and comprehensive talents of the author. Lecture v. may be for him the acme of his treatise, for in it he develops and emphasises his well-known contrast of the precious uses of general anæsthetics, with the intimate perils of their ordinary application; but in no pessimist spirit, in the assurance rather that under scientific guidance these uses can be had without the perils. How great under rule of thumb these perils have been, and still may be, he does not hesitate to declare with the authority which belongs to one in whom to the talent of scientific discovery are added the practical dexterity of the mechanic and the enthusiasm of humanity. Prof. Waller believes that he has eliminated "idiosyncrasy"; and he anticipates a like dismissal for the "status lymphaticus." The last chapter—an appendix—is reserved for some notes and general reflections arising out of what has gone before, reflections full both of insight and accomplishment.

I had marked many passages for especial notice, but I see that in such a quest I should soon trespass beyond my limits. I will rather engage the reader of this notice to procure the little book for himself, advice which I offer, not only to medical, but to all readers of NATURE; for it is the note of a master of his subject that in addressing a larger public he can make it intelligible to every trained mind whatever its pursuits. And the paragraphs are full of happy and illuminating sidelights; for instance, on the "line of beauty" (p. 65), I have heard Watts say more than once that for the painter the line of beauty is one which cannot return into itself. From the time of Haller, or indeed from Harvey, physiology has been very fortunate in its exponents, a good fortune which it still enjoys.

CLIFFORD ALLBUTT.

THE PINES OF AUSTRALIA.

A Research on the Pines of Australia. By R. T. Baker and H. G. Smith. (Technological Museum, N.S.W., Technical Education Series, No. 16.) Pp. xiv+460. (Sydney: William A. Gullick, Government Printer, 1910.)

THE joint authors of this book are both officers of the Technological Museum of New South Wales, acting in the botanical and chemical departments respectively, and also joint authors of a similar "research" on the genus Eucalyptus, published some years ago. Beginning with the title of the present work, we question its appropriateness, though there may be local considerations which justify its adoption. To what extent the names "Moreton Bay Pine," "Cypress Pine," &c., are used, outside of books, is uncertain. Here, in the northern hemisphere, the term pine is by no means applied uniformly, but its use is restricted to the Abietaceæ, no member of which is a native of Australia. A criticism of this kind is easily put forward, but it is difficult to find a more suitable and popular name, as the family designation, Coniferæ, is equally open to objection, in view of a classification based on relatively recent researches. Mr. Baker, however, might have consistently used the term Coniferæ, inasmuch as he accepts and employs the classification and terminology of Bentham and Hooker's "Genera Plantarum," in which the six groups, Cupressineæ, Taxodieæ, Taxeæ, Podocarpeæ, Araucarieæ, and Abietineæ are regarded as tribes of one family or natural order—the Coniferæ. All these groups, except the last, are represented in the indi-

genous vegetation of Australia, and eleven of the thirty-two genera described by Bentham and Hooker are in part, or wholly, Australian, with a total of thirty-seven species. Of these Araucaria and Agathis (Dammara) are the only genuine cone-bearing genera; the former being also represented by recent species in Brazil and Chili, and the latter is spread over the Malayan Archipelago and extends to New Zealand and some of the Pacific Islands.

Coming to the plan of the book and the treatment of the subject, it should be explained that the main object of the investigations was to ascertain, describe, and illustrate the "commercial possibilities" of the various species of the Australian Coniferæ. The genus Callitris (otherwise Frenela)—to which Mr. Baker applies the popular name Cypress generically, in spite of his title—as now generally circumscribed, is almost restricted to Australasia (Australia and Tasmania). Two species, however, occur in New Caledonia, a fact overlooked apparently by Mr. Baker. There are eighteen Australian species, and they are spread over the whole country. Its nearest allies are African, and they have sometimes been referred to the same genus; but Mr. Baker, following other authorities, retains the North African Tetraclinis, and the South African Widdringtonia, which he diagnoses anew. Callitris is the only genus of Coniferæ of general dispersion in Australia, and the vast areas covered by some of the species will come as a surprise to most botanists. Mr. Baker gives very full details of the distribution of the Australian Coniferæ, but more especially within the State of New South Wales. *Callitris glauca* is found in all the States, "but nearly always away from the coast." Ten pages are devoted to its distribution in New South Wales, where it is known to occur in eighty-seven counties, covering hundreds of thousands of acres. *C. glauca* is perhaps the most important of all the small trees of Australia, as its timber (as well as that of other species of Callitris) is impervious to the white ant.

This species is illustrated by about thirty figures, from the habit of growth of the individual to the anatomy of the various parts. Altogether the work contains 296 figures of anatomical structure and chemical secretions, all photographic reproductions, some in colour and mostly of excellent quality. In addition there are about seventy unnumbered plates or full-page illustrations, some of which are scenic, others individual trees, while others represent herbarium specimens of the natural size. Unfortunately an index to the figures and plates is wanting. There are also three maps, one of which illustrates the distribution of the Coniferæ of New South Wales so far as at present known. In the compilation of this map the authors had the assistance of about 130 persons, mostly schoolmasters and mistresses. Assuming that they afforded trustworthy information, it is evidence of an interest in natural history not easily paralleled. As already mentioned, the chemical composition of the various products, the results of very protracted investigations, is given in considerable detail. In addition there is much practical information. Comparing the number of species cited, it will be seen that an average of twelve pages is devoted to each; more or less, according to their importance. Much space is devoted to anatomy and chemistry, and more might have been profitably given to morphology and a discussion of the theoretical structure of the female cone and the male catkin of the earlier writers. The term gymnosperm is mentioned, but no definition follows, and for a description of the family the reader is referred to Bentham and Hooker's "Genera Plantarum," as Mr. Baker considers it "would be superfluous to repeat it," losing sight of the fact that this classical work is expensive and accessible to comparatively few persons, besides not being up-to-date in many details.

W. B. H.

PRACTICAL INORGANIC CHEMISTRY.

A Manual of Practical Inorganic Chemistry, including Preparations and Qualitative and Quantitative Analysis, with the Rudiments of Gas Analysis, specially adapted to cover Preliminary and Intermediate University Courses and the First Three Stages of the Syllabus of the Board of Education. By Dr. A. M. Kellas. Pp. viii+347. (London: H. Frowde and Hodder and Stoughton, 1910.) Price 5s. net.

THIS volume belongs to the series of Oxford medical publications, in which an "Introduction to Practical Chemistry" was published by the same author in 1909. A comparison of the two volumes shows that nearly two hundred pages of the texts are identical, and there can be little doubt that the type set up for the earlier publication has been used in the production of the major portion of the present volume.

Amongst the new matter may be noted a section dealing with preparative work of a more advanced character. The preparations described include the chlorides and oxides of sulphur, phosphorus, and silicon, the chlorides of iron, aluminium, and tin, bleaching powder, potassium chlorate, chromate, bichromate and permanganate, sodium nitrite, calcium hypophosphite, and sodium thiosulphate. The list of metallic compounds, of which the mode of preparation is described, has, moreover, been extended so as to include practically all the inorganic compounds in the British Pharmacopœia. A summary of these compounds is given, in which the impurities to be looked for are in each case indicated. This extension is evidently designed for the special purposes of pharmaceutical students, and can scarcely be regarded as an enlargement in the scope of the work from a chemical or an educational point of view.

In the section dealing with the identification of acid radicles, the reactions of some thirty-three acids are given in the *Manual* as compared with sixteen in the *Introduction*. The short section devoted to quantitative analysis in the latter has been expanded from about twenty-five to seventy-five pages in the new volume, and in addition to several new gravimetric estimations, the commoner volumetric methods are described. This and the last section, in which the author gives an account of the apparatus and methods used in quantitative gas analysis, represent the greater part of what is not to be found in the previous volume.

The new matter is presented in a very lucid form, and from the instructions and detailed explanations, which are intended to lighten the work of the teacher, the average student should find little difficulty in working intelligently in the laboratory without much supervision.

In connection with the formulation of chemical changes, a brief reference is made to the theory of electrolytic dissociation, and the reader is informed that the reactions involved in analysis are, as a rule, ion reactions. If this is really the case, it is difficult to justify the author's use of ordinary chemical equations in preference to ionic equations, even if it be admitted, that, in some cases, the representation of oxidation and reduction changes is not quite so simple when the ions are taken into consideration.

In view of the undoubted merits which the book possesses, it is distinctly unfortunate that nearly two-thirds of the contents should be a mere copy of a previous and very recent publication. There is nothing in the titles of the two books to suggest such a large measure of identity in respect of text and diagrams to prospective purchasers, and it is to be regretted that the publishers should have seen fit to proceed to publication in this particular way. H. M. D.

MATHEMATICS AND OPHTHALMOLOGY.

The Prescribing of Spectacles. By A. S. Percival. Pp. vi+159. (Bristol: John Wright and Sons, Ltd.; London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd., 1910.) Price 5*s.* 6*d.* net.

DR. A. S. PERCIVAL is one of the most eminent of the comparatively few English ophthalmologists who have shown the requisite knowledge to treat mathematically in an exhaustive manner optical problems connected with the eye. The ordinary student of ophthalmology is content to accept on authority the results obtained by others, or at most to study such geometrical expositions as may be readily understood. Indeed, he is generally wholly incapable of comprehending an analytical proof, and nothing is so abhorrent to his mind as an algebraical formula. It is greatly to be deplored that more emphasis is not laid upon the acquirement of a good knowledge of physiological optics, a subject which necessarily forms the very foundation of ophthalmology. Moreover, by far the greater part of every ophthalmic surgeon's work consists in the correction of errors of refraction, of defects in muscle balance, and other problems of an essentially optical nature. Only those who have given assiduous attention to the mathematical conditions presented by these problems can appreciate the help which this arduously acquired knowledge gives them. It is a humiliating fact that many practising opticians are far better equipped in this respect than most ophthalmic surgeons, and if the latter seriously expect to hold their own against the encroachments of the former they must outrival them on their own ground.

Dr. Percival's little book will prove of valuable service in the task. All the common problems which daily confront the surgeon in ordering spectacles for errors of refraction and defects of muscle balance are discussed, and the underlying principles lucidly explained. In most cases mathematical proofs, culled from the author's work on optics and other original papers, are set forth. Dr. Percival's name is specially associated with the formulæ for periscopic glasses, and the inquiring student will here be enabled to find out how the formulæ were arrived at, and why such lenses are to be preferred. A few paragraphs, such as the pinhole test of ametropia, might have been omitted as of little practical value, and the student would do well to read Maddox's book on the "Ocular Muscles" in conjunction with the chapter devoted to the subject in this work. The author's advice is always founded on a secure scientific basis, and such paragraphs as the following show that he is not carried away by purely theoretical conceptions. In speaking of the association between accommodation and convergence he says:—

"Clearly, if the relation between the two functions is unfitted for present requirements, and if there is no sufficient faculty of adaptation that can be brought into play by training, we should make the glasses suit the patient, instead of vainly attempting to make the patient suit the glasses."

And again:—

"In conclusion, I would say that although few patients will require such a complete examination as is here suggested, yet it is well to investigate the relationship of these functions of convergence and accommodation whenever symptoms still persist after the correction of any refractive errors and hyperphoria that may exist."

We can cordially recommend the book, and we hope that it may stimulate many ophthalmic surgeons to acquire a more profound knowledge of this branch of their subject.

THE BEETLES OF INDIA.

The Fauna of British India, including Ceylon and Burma: Coleoptera Lamellicornia (Cetoniinae and Dynastinae). By G. J. Arrow. Pp. xiv+322+ii coloured plates, and 76 illustrations in the text. (London: Taylor and Francis, 1910.)

THE beetles of India are an enormous subject, and the volume before us only deals with two subfamilies of the great group Lamellicornia, the first of which, though comprising the well-known and extremely interesting rose-chafers, is only represented by a few species in Britain, while the Dynastinæ, though a few species are found in southern Europe, is not represented in the British fauna at all. Two hundred and eighty-seven species of these two subfamilies are here described as belonging to the Indian fauna, but the editor's estimate of these being "perhaps less than one-sixth of the great 'series' of Lamellicornia," is perhaps somewhat too high, when we consider that the Lamellicornia include the whole of the chafers, the sacred beetles, and the stag-beetles.

Mr. Arrow has been fortunate in receiving the cooperation of the curators of most of the principal entomological collections in Europe and India, and of many enthusiastic and experienced collectors in India and Ceylon, and his work may therefore be taken as a trustworthy epitome of what is at present

known relating to his subject. The glossary of technical terms which follows the preface will be useful, and there is also a comprehensive introduction of upwards of thirty pages in which the structure is fully described, and clearly illustrated by diagrams. These are points which are frequently too much neglected by entomological authors, but which are of real practical importance. Besides general remarks and a section on structure, the introduction deals with larvæ, vocal organs, sexual dimorphism, food and habits, and classification. The Lamellicornia beetles are mostly vegetable feeders, or dung or carrion beetles, and some of them, like our own cockchafers, are very destructive to grass in the larval stage, and to leaves of trees when mature. Some, chiefly belonging to the groups described in the present volume, inhabit the nests of ants and termites in the larval stage, and are tended by these insects for the sake of their secretions, while the dung and carrion beetles are general scavengers.

The Lamellicornia, as their name implies, are distinguished by their short lamellated antennæ, which may be observed in a well-developed and characteristic form in our common cockchafers. Mr. Arrow recognises three main families, the Scarabæidæ, Passalidæ, and Lucanidæ. The Passalidæ are not European; the Lucanidæ are the stag-beetles. The Scarabæidæ are divided into two smaller divisions, the Pleurosticti, with four subfamilies represented in the Indian fauna, and the Laparosticti, with eight.

The general arrangement of the volume is similar to that adopted in previous volumes of the "Fauna of India," and need not be further commented on here. Eight species are represented on each of the coloured plates.

We congratulate Mr. Arrow on the completion of an excellent piece of work, and hope that entomologists may have reason to be grateful to him for a long series of equally excellent volumes.

W. F. K.

ELECTRIC MOTORS.

Electric Motors. Continuous, Polyphase, and Single-phase Motors: Their Theory and Construction. By Henry M. Hobart. Second edition, entirely re-written, revised, and enlarged. Pp. xxiv+748. (London: Whittaker and Co., 1910.) Price 18*s*. net.

THE first edition of this work appeared in 1904. Since then remarkable advances have been made in electrical engineering. A foremost place in this progress must be given to electric motors, and more especially to that class employing commutators, in connection with both single- and poly-phase alternating currents. Indeed, the electrification of railways has made the variable-speed single-phase motor with a good starting torque indispensable, for at present the single-phase system alone seems to fulfil the requirements of main line electric traction. Also the polyphase induction motor is no longer to retain the great disadvantage in the matter of speed regulation, which makes it inferior to the continuous-current shunt motor, for successful means are now known whereby the speed may be varied economically over a wide range.

Both these problems are discussed in the present edition, and form part of the new material contained therein, but we find the treatment is mainly descriptive and too general to be of much use to anyone seriously engaged in the design or manufacture of these machines. Admittedly the subject is a difficult one, at any rate, more difficult than the design of ordinary continuous-current and induction motors. Nevertheless, in a book on the theory and construction of electric motors room ought to be made for a proper scientific study of these recent developments.

Coming to the other and major part of the book dealing with more or less *standard* motors, we do not find much improvement on the first edition. To a scientific engineer the author's style is too roundabout, illogical, and non-mathematical. A German engineer would probably call it "unpedägogisch." For instance, the author treats the principles of design by means of examples. Surely the classical way of developing formulæ from the theory, followed by practical details, and illustrated by examples, is far better. Nor—to judge from his examples—does the author appear to have kept pace with the times. We can only think that many of the designs, both of continuous- and alternating-current motors, have long since been repudiated by their respective firms.

The methods of calculation advocated by the author are often open to objection, but to cite instances would take us too far, as the list before us is really too long to choose from. We think enough has been said, however, to show that, while appreciating the immense amount of information the writer has collected, we cannot agree he has produced a book which can be regarded as a standard treatise on the theory and construction of electric motors for the use of students or scientifically-trained engineers.

STANLEY P. SMITH.

THE GEOLOGY OF GERMANY.

(1) *Lehrbuch der Geologie von Deutschland. Eine Einführung in die erklärende Landschaftskunde für Lehrende und Lernende.* By Prof. J. Walther. Pp. xv+358. (Leipzig: Quelle and Meyer, 1910.) Price 7.60 marks.

(2) *Geologie von Deutschland und den angrenzenden Gebieten.* By Prof. R. Lepsius. Zweiter Teil, Lief. ii., Das nördliche und östliche Deutschland. Pp. vi+247–548. (Leipzig: W. Engelmann, 1910.) Price 10 marks.

(3) *Geologie von Ostpreussen.* By Prof. A. Tornquist. Pp. vii+231. (Berlin: Gebrüder Borntraeger, 1910.) Price 10 marks.

(1) PROF. WALTHER has been fortunately compelled to write an account of the geology of Germany, in furtherance of the scheme to which he stands committed. He is one of those educational leaders who believe that knowledge of literature and of cosmopolitan science is insufficient for the citizen. The Fatherland itself, *solum patriae*, must be understood in order to be loved. We must not begin and end with arranging minerals in cabinets and pointing

out their technical applications. Let us appeal rather to the country round the pupil's home. We want, says Prof. Walther, a wider opening of doors and windows. He would play, like the famous piper of Hameln, a tune full of the magic of the world. The school must follow him, when the sun reveals the peaks of far-off ranges, and when the wind swirls the dust in clouds across the slopes. It must follow, when the rain furrows the farmlands, and the roaring stream undercuts its trembling banks. Nature is ready to reveal its beauties, small and great, and comparison with other lands will yet increase a love of home.

With such stirring words this vigorous work sets out. The illustrations are almost all from places that the author knows. They have been drawn with brush or pencil by Herr Weszner from photographs and other trivial sources, with an art that seems coarse at first sight, but which grows very quickly on the reader. The painter has understood his author—note the simple desolation of the "Baumfriedhof" among the dunes (p. 5), the cemetery of trees; the renowned quarry of Solenhofen (p. 94), on a plateau above the village, where the level strata appeal so temptingly beyond the woods; or the vivid little sketch (p. 256) of Karlsbad crowded in its ravine; and compare this last with the glimpse of Regensburg (p. 293), seated like an island in the alluvium, as one sees it for the first time in descending from the hills. The essentials are all there, just as in the text, which is pure literature. The geological map, however, is far too severe and uncommunicative. Even the German schoolboy might hesitate before a group of towns named Mü., La., Er., and Rud., in the country east of Eis., which we conclude is Eisenach. The Porta Westfalica is figured, and might well be named; we seek it on the Weser between Ha., the city of the piper, and Mi., probably the place of the "men who fought." We have some acquaintance with the Vistula, and can look with interest on Th., Mbg. (recalling a watergate on the Nogat), and even Di., a railway junction; but we cannot recover Cu. We are writing far away from atlases, and there is no need for so many puzzles in a work that connects geography and geology. But this shall be our only grumble, though we believe that another map on p. 125, full of attractive river courses, is on only one-tenth of the scale ascribed to it. Theoretical questions are not overlooked by the author, when once he has aroused interest in the origins of things. We are brought to contemplate the yielding but sustaining *Untergrund* on p. 28; we gaze on a north pole in the middle of Greenland during the Ice age (p. 113); and we picture intelligent apes using eoliths in the Miocene period (p. 128). Throughout its first two sections the book stands successfully apart from most of our attempts at "nature-study." While we are apt to insist on the beauty of things, Prof. Walther makes us know that they are beautiful by his telling of them. In the third section, he leads us to a closely written description of the origins of German landscape; but we still come across vivid touches that enable us to realise the past. We should like to quote the description (p. 171) of the volcanic cloud caught by westerly winds above the crater of the Laacher See, or the passages that trace the history of the granite tors which rise on the Fichtelgebirge through the woods (pp. 242–3). Teachers will select and enlarge the descriptions of their special areas; but they will learn to adopt a comprehensive view of natural phenomena that will fit them, in Walther's opinion, to live upon this living world.

(2) Prof. Lepsius has carried his great work on the geology of Germany to the end of its second volume, and it remains a storehouse of well-chosen references to original research. Some of these must have found their way into the book almost during its passage through the press. The author was never a mere compiler, and in the present part he adds greatly to the interest of his subject by a full discussion of recent views on the deposits of the north German plain. He holds that there is no doubt as to the advance of ice from Scandinavia over this vast area; but he will not countenance the suggestion of interglacial epochs. The evidence for these he regards as local, and as supporting his belief in prolonged Scandinavian glaciers, rather than in a continuous ice-sheet (p. 477, *et seq.*). He does not accept Greenland as an existing parallel for what occurred in northern Europe, and quotes Schwarz with approval as to the maximum thickness of an ice-flow (p. 475). He sees the cause of the Ice age in geographical conditions, and attributes the Dwyka Conglomerate of South Africa (p. 514) merely to the elevation of a mountain chain. He allows of great movement of blocks of chalk by advancing ice, but does not accept the evidence for plucking action. All this shows that the author's spirit aims far beyond mere description, and that he is quite prepared to champion views which others have set aside. We have dwelt on this part of the book rather than on the fine and detailed description of the Harz area (pp. 286–410), where Prof. Lepsius critically reviews the work of Lossen, on the basis of personal observations. His readiness to adopt new views where he holds them to be justified is never left in doubt, a good example being his treatment of the mingled types of igneous rocks on the margin of the granite of the Harz (p. 350). Nor does he shrink from controversy, when he claims to have converted an eminent colleague (p. 443) to his undoubtedly sound opinions on the famous Saxon granulites. Prof. Lepsius has now furnished us with one of the most serviceable reference books on the geology of Central Europe.

(3) Truly the geologist is happy anywhere. Prof. Tornquist writes on the geology of Ostpreussen with enthusiasm. This remote province, as he justly remarks, is known to few besides those that dwell in it, but to them its very expanse is beautiful. In his handsome volume we learn much stratigraphy from the fossiliferous pebbles that are embedded in the covering of glacial drift. We hear of interesting formations that are reached by borings, and the mantle of clays and sands seems to the student to cover fascinating mysteries. The derived fossils are beautifully illustrated, and the amber, with its included insects, is ascribed mainly to the Lower Oligocene of Samland (p. 98). The discussion of the drift leads

to an account of the oscillations of the margin of the Scandinavian ice, and the formation during a resting epoch of massive terminal moraines. A block of Miocene sediments with undisturbed bedding, including brown coal, and 30 metres thick, has been found at Georgenswalde, as a transported inclusion in the boulder-clay (p. 150). Marine clays with Yoldia and many other molluscs are regarded, in opposition to recent views in Sweden, as older than the maximum extension of the ice. These beds seem, indeed (p. 156), to have been deformed by the pressure of the ice. One great forward movement of the glacier-front, and one retreat, broken by pauses and small oscillations, are held (p. 159) to explain the phenomena in Ostpreussen. During a pause, which Prof. Tornquist explains by the sinking of the ice into yielding glacial deposits in a great depression in the south-east of the province (p. 175), the pre-Glacial marine sands and the earlier ground-moraines are said to have been pressed up as a ridge, just as the growth of the dunes along the northern coast has pressed up modern marine beds out of the sea (*cf.* p. 209). The photographs give vitality and interest to a strange monotonous country, which we well remember, as we crossed it under grey September clouds. The view of Neidenburg (p. 167) reminds us of the gravels washed from the retreating ice, and of the last villages of Prussian Poland, joined by tracks of trampled sand. On this broad outwash plain, the white-capped Cossack riders, night and day, keep the boundary between east and west along the fenceless fields.

GRENVILLE A. J. COLE.

OUR BOOK SHELF.

Orchids. By James O'Brien. Pp. xii+114. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price 1*s.* 6*d.* net.

IN the preface to this little book it is observed that householders in suburban districts who have but one conservatory may, if they choose, keep it furnished with orchids at a less expenditure of time and money than is needed for the usual occupants of such structures. Frankly, we doubt it. The same thing has been written many a time before and doubtless many a confiding householder has tried to do it, but so far as we can judge the successes are few and far between. The author of this work has devoted his life mainly to the study and cultivation of orchids, and, like most experts, is apt to take for granted a knowledge of certain fundamental principles which for himself require as little consideration as breathing, but which are nevertheless absolutely essential to success. It is over these that the average suburban householder with no special training comes to grief. No doubt it can be done, especially by persons with abundant time on hand, and plenty of enthusiasm; but not by the ordinary City man who has to leave his orchids—their shading and ventilation —to the tender mercies of the jobbing gardener or the occasional attentions of a distracted housemaid from ten to six, the most important part of the day in orchid culture.

But whilst we cannot support the optimistic views as thus expressed by the author, we can strongly recommend his book. It gives a condensed, but wholly admirable, account of the history of orchid cultivation, of the structure of orchid flowers, of the principles of building orchid houses, and the best short account we have yet seen of how to cultivate these plants. Many who have themselves spent years amongst orchids will read the book with profit and pleasure. It is well printed, and is illustrated by eight coloured pictures made from plants grown in the famous collection of Sir G. L. Holford, at Westonbirt. They represent the acme of the orchid cultivator's art.

Practical Mathematics and Geometry. By E. L. Bates and F. Charlesworth. Pp. viii+446. (London: B. T. Batsford, 1910.) Price 3*s.* net.

THIS book has been written with the view of meeting the recent addition to the Board of Education examination syllabus, which unites arithmetic, algebra, and practical drawing under the heading of "Preliminary Practical Mathematics." In deciding the question as to the best teacher for the combined course the following points cannot be ignored. The mathematical teacher as a rule cannot be entrusted to teach draughtsmanship—one of the most important lessons a young technical student has to learn, and one which, if spoiled at the start, is rarely remedied later. On the other hand, the engineering teacher is apt to attempt to specialise in mathematics too early; again, his time is generally fully occupied with his own special work.

The book before us contains 446 pages crowded full of matter presumably considered essential for a first year's evening course. It includes mathematical work up to quadratic and other equations, logarithms and variation, and plane and solid geometry up to the projections of simple solids and their sections. There is little attempt to coordinate the mathematical and drawing work.

Introduction à la Métallographie Microscopique. By Prof. P. Goerens. Edition Française traduite par Prof. A. Corvisy. Pp. 227. (Paris: A. Hermann et Fils, 1911.) Price 10 francs.

THE English translation from the German edition of this work appeared more than two years ago, and was reviewed in NATURE, vol. lxxviii (1908), p. 387. The present book, however, is not identical with any previous issue. It is a careful revision by F. Robin, and is in advance of its predecessors in several respects. The arrangement is somewhat more logical, the description of the measurement of temperature by thermocouples being followed at once by a section devoted to the methods employed in studying the microscopic structure of metals, and the remainder of the book is occupied by an account of the constitution of alloys, illustrated by a very large number of examples. The iron-carbon alloys are dealt with in detail in a separate section. The most important additions of new matter are descriptions of many series of binary alloys, which have been studied during the last three or four years, and a large number of beautiful reproductions of photomicrographs of the structure of metals.

Das Radium und die Farben. By Prof. Dr. C. Doelter. Pp. viii+133. (Dresden: Theodor Steinkopff, 1910.) Price 4 marks.

THIS is a useful summary of the very numerous observations which have been made on the colour phenomena produced in minerals by the neighbourhood of radio-active bodies. Although the facility with which experiments can be made with radium (at least by the fortunate possessor of an adequate specimen of that substance) have given a special prominence to observation made with it, it is well known that analogous colorations are produced by kathode and Röntgen rays, and by ultra-violet light. These subjects are included in the book, which contains a full bibliography.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Drainage and Malaria.

THE writer of the paragraph upon Drainage and Malaria in the "Notes" of NATURE for September 15, 1910, is evidently unaware that the facts as they relate to Klang and Port Swettenham, the two stations mentioned, lend themselves to a quite different interpretation from that put forward. The idea conveyed by the paragraph referred to is that two intensely malarious places have been freed from malaria by drainage alone, with a saving of more than 400 lives per annum.

A study of the reports that have been published from time to time by Drs. Travers and Watson, the medical officers who claim to be responsible for this remarkable achievement, reveals the following facts.

Klang is the principal town in a district of that name in the Federated Malay States. Port Swettenham is a new port situated five miles from Klang. It was opened in 1901. The total population of Klang district for 1901 was 18,110, of which 3576 belonged to Klang town. In 1903 the population of Klang and Port Swettenham together was estimated at about 4000.

From 1898 to 1904 the total deaths registered in the town and district together were as follows:—

	1898	1899	1900	1901	1902	1903	1904
Total deaths ...	475	538	780	998	547	543	612
Rate per 1000 ...	26·3	31·0	43·0	55·4	30·3	30·1	34·0

It will be seen from this table that the mortality rose very markedly in 1900 and 1901, and fell sharply in 1902.

An analysis of the returns shows this to have been due to an extraordinary temporary increase in the mortality of Klang town during these two years. The following table gives the mortality in the towns from 1900 to 1904 compared with that of the rest of the district:—

		1900	1901	1902	1903	1904
Towns	Total	474	582	144	115	122
	Per 1000 ...	132·5	162·7	36·4	28·7	30·5
District	Total	306	416	402	428	490
	Per 1000 ...	21·8	29·7	28·7	30·5	35·0

A consideration of these figures indicates that some special influence must have been at work in Klang town to cause the appalling mortality of 1900–1, and the history of local events gives the clue to this.

At one time Klang was both port and railway terminus of the district, but in 1897 it was decided to construct a new port five miles beyond Klang. The site chosen was a mangrove swamp partially submerged by every high tide; and for the reclamation of this, the making of railway embankments and the construction of approaches to the wharves and building sites, earth had to be brought from a distance. While the work was in progress, the coolie labourers employed suffered severely from malaria, which increased in severity as the work approached completion. The health of the town was also affected, and when at last the new port and railway were opened on September 15, 1901, and a large number of Government servants and others connected with the shipping were transferred from Klang to quarters at Port Swettenham, many of them contracted malaria.

This appears to have seriously alarmed the authorities, who had remained unmoved at the fearful mortality that had taken place before the opening of the new port, and, as a result, steps were taken to draw up a scheme for the drainage of both stations. Meanwhile, quinine was freely administered as a prophylactic with such good effect that a marked improvement was recorded even before the drainage schemes could be executed. The epidemic which had raised the mortality to such a frightful figure in 1900 and 1901 declined very rapidly after the opening of the port and railway, and the total number of deaths during 1902 was less than one-quarter of those in 1901.

To those acquainted with conditions in the tropics, the occurrence of an epidemic of malaria during the construction of a new port and railway, and its disappearance after the completion of the work, occasions no surprise, for it is just what has happened hundreds of times in the past.

In the East, the coolie labourers employed on such works are drawn almost entirely from the poorest and most ignorant classes of the population; they are often brought long distances and set down in a country in which the climate, and even the food obtainable, differs greatly from that to which they are accustomed; if housed at all, they are generally crowded into temporary huts, but frequently they are left to find what shelter they can; they have often no one to look after them when sick, and no means of obtaining food if for any reason they are unable to work. Their work is arduous and their pay small, and owing to the fact that they generally try to save money for the support of dependants at home, it is no uncommon thing to find them attempting to exist upon a miserably insufficient diet. Camped as they usually are upon the site of the work, their surroundings are almost always highly insanitary, for there is rarely any pretence at a conservancy system, and sometimes no proper water supply; and if much earth-work is going on, the numerous pools of water formed during the rainy season speedily become the breeding places of countless swarms of mosquitoes. In these circumstances it is not surprising that coolie labourers on large public works should be decimated by outbreaks of epidemic disease. But whatever happens to the coolies, the work has still to go forward, so that as long as it is in progress there is continual immigration of new labourers to fill the gaps caused in the labour force by sickness, desertion, and death. This continual immigration is a further source of mischief, for the constant introduction of gangs of susceptible newcomers into camps which have already become hotbeds of disease increases the trouble, just as the addition of fuel to a glowing fire increases the blaze.

Those who, like the writer of this letter, have watched the course of epidemics of this kind among Indian coolies, cannot fail to trace in the history of events at Klang and Port Swettenham a similar occurrence. It may be remarked that the epidemic at these places began among the labourers on the work, and increased in severity as that work progressed; it occasioned a fearful mortality, such as is never seen except in conditions similar to those described above; and just as its origin can be traced to the construction of the new port and railway, so also can its decline be traced to the completion of this work. Once a big project of this kind is finished, the labour force rapidly disperses, immigration of the class of labour employed ceases, a settled population takes its place, and conditions as regards health rapidly approach the normal once more.

In these circumstances it becomes difficult, if not impossible, to estimate the value of the drainage projects that were carried out at Klang and Port Swettenham after the decline of the epidemic, for it is certain that in any case there was bound to be a great improvement after the completion of the work on the new port and railway, and the dispersal of the labour force engaged on their construction. The only legitimate method of testing the results of the drainage of the two stations is the comparison of the mortality rates of Klang prior to the commencement of construction work for the new port and railway with those recorded after the introduction of the drainage schemes, and until this has been done it is misleading to claim these places as demonstrating the value of drainage in combating malaria.

As for the statement that more than 400 lives per annum have been saved by the drainage of Klang and Swettenham, it is an absurd fiction based on the ridiculous assumption that but for the drainage schemes the enormous rate of mortality recorded in 1901 would have continued unchecked. CHAS. A. BENTLEY.

Bombay, October 22, 1910.

I HAVE read with interest Dr. Bentley's interpretation of the figures relating to the anti-malarial works at Klang and Port Swettenham published by Dr. Travers and myself, and I am familiar with Dr. Bentley's valuable paper on the human factor in malaria. This factor is,

undoubtedly of profound importance in certain outbreaks; but at Klang and Port Swettenham the sequence of events was not to be explained by Dr. Bentley's theory, and he has, I think, overlooked two points in my published reports which at once set aside his explanation of the figures.

The suggestion is that the origin and sustaining factor in the outbreak was a camp at Port Swettenham densely populated with coolie labour, the coolies of which not only suffered severely from malaria, but also infected the other inhabitants of the port and of Klang, and that when the construction works at the port were finished at the end of 1901, the camp was broken up, the coolies dispersed, and the epidemic subsided.

If this theory be correct, we should naturally expect to find evidence of a severe outbreak among construction coolies at Port Swettenham during 1901.

As a matter of fact, not only was there no outbreak of malaria among coolie labourers at Port Swettenham, but there were actually no camp coolies. There is abundant evidence that this was the state of affairs, although, as the port was not opened until the end of the year, it was not unnatural for Dr. Bentley to suppose such a camp existed.

To explain, I may say that most of the earth construction was finished at the end of 1895 (Dr. Travers gives the date of beginning work as 1897, but this is a slip; see *Journal of Tropical Medicine*, 1903). The wharves were finished at the end of 1900. The only works then remaining to complete the port were three iron goods-sheds and the passenger railway station, for which skilled labour was required. This was not forthcoming, and these few buildings were not finished until September 15, 1901, when the port was opened. Through trains were, however, running from June, 1901.

On my first visit to Port Swettenham, in January, 1901, instead of finding a great camp of coolies as suggested by Dr. Bentley, I found only some twenty or thirty persons. Instead of poorly paid coolie labourers, there were high-paid Chinese artisans. Except for these few Chinese, occupying one of a series of empty huts formerly occupied by the construction coolies, the place was deserted. The Government quarters on each side of the main road also stood empty, and were not to be occupied until some nine months after my first visit to the port.

This is a condition of affairs so completely different from what is demanded by Dr. Bentley's theory, that the theory obviously becomes untenable; and to show that such was actually the state of affairs in 1901, I now give some extracts from published reports.

A.—*Evidence of date of beginning works.*

"The extension of the Klang line from Klang to Kuala Klang (former name of the Port) was commenced on January 1, 1895, and at the date of writing (April, 1896) is nearing completion. It is not proposed to open this line until the wharves at the mouth of the river have been completed" (see Report of Resident Engineer, Railways for 1895, Selangor Government Gazette, 1896).

B.—*Evidence that wharves were completed at the end of 1900, and that remaining work was for artisans, who were difficult to obtain and keep at Port Swettenham.*

"The works remaining on hand are the passenger station and goods-sheds, which are being pushed on as fast as the difficulty of keeping skilled labour at this unpopular spot will permit. It is anticipated that the whole of the work will be completed by the middle of the present year" (see Administration Report for 1900, Selangor Government Gazette, 1901).

C.—*Evidence that artisans were not poorly paid and were scarce.*

Under the head of "Labour" in the Administration Report on Selangor for the year 1900 (Selangor Government Gazette, 1901), the British Resident wrote:—"More serious difficulty is caused by the great dearth of artisan and mechanical labour, the available number of skilled workmen having declined rather than advanced. . . . The mechanic of this country is almost always a Chinaman. He can do good work, and is well paid for it, and is consequently very independent. Latterly employers even of their own nationality have been quite unable to get the men they require, and works of all description have suffered in consequence."

D.—*Evidence that there was no great coolie population at Port Swettenham in* 1901.

"I was not surprised that the construction coolies had suffered severely from malaria, and although at the beginning of 1901 few coolies were actually living in Port Swettenham, I formed a very unfavourable opinion of it owing to the short residence necessary to infect new-comers." This is an extract from my Official Report to Government on the anti-malarial works at Klang and Port Swettenham. It was published in the Selangor Government Gazette, April, 1905, and reprinted in the Indian Medical Gazette of September, 1905. Dr. Bentley has, I think, overlooked this report.

E.—*Evidence that there was no great epidemic of malaria at Port Swettenham in the early half of* 1901.

If there was a great epidemic of malaria at Port Swettenham among coolies in 1901, one would expect to find evidence of it in the admissions to hospital. Now, in my articles in the *Journal of Tropical Medicine* in November and December, 1903, and April, 1905, a table appears giving the monthly admissions to Klang Hospital of cases of malaria from the port. The numbers were as follows:—January, 3; February, 0; March, 3; April, 4; May, 0; June, 5. During the six months, consequently, which Dr. Bentley supposes to have seen the culmination of a malaria outburst which almost annihilated Klang and Port Swettenham, the cases of malaria admitted to the hospital from the vortex of the storm numbered no more than 15. Dr. Bentley can scarcely have noticed these figures.

So far from Dr. Bentley's suggestion being correct, the figures show that the construction coolies had left Port Swettenham long before the great outbreak arose among the Government population, and those connected with the shipping who went to reside there after the port was opened. The epidemic at Port Swettenham, which arose in 1901 after the port was opened, was not among, or in any way connected with, poorly paid construction coolies, but among Government servants and their families, the shopkeepers, and the well-paid loading labourers (180 in number) who were transferred from Klang. Beyond these there was no population at the port. The outbreak began nine months at least, to my personal knowledge, after the construction coolies had left, and consequently it is impossible to attribute the subsidence of the outbreak to their departure.

With regard to Klang town, I cannot quite gather whether Dr. Bentley means it to be understood (*a*) that construction works and a coolie camp existed at Klang as well as at Port Swettenham, or (*b*) that the coolies from Port Swettenham infected Klang town.

If the former, I may say at once that no such works or such a coolie camp existed at Klang.

If the latter, why should Klang, formerly so susceptible of infection, be now immune? In the nine years which have passed since the outbreak in Klang, there has been an enormous increase in the populations of the towns and of the district. Places with much larger populations than that of Port Swettenham in 1901, or even to-day, and places much nearer than Port Swettenham to Klang, have been devastated with epidemics of malaria. Malarial subjects from these surrounding neighbourhoods now enter Klang in far greater numbers than nine years ago from Port Swettenham. Yet the residents of Klang do not suffer from malaria, and statistics show that malaria is hardly ever contracted in Klang to-day. Of 455 Klang children examined in 1909, thirteen only showed evidence of malaria. Of these thirteen, not one but had recently come to Klang, and had a history of malaria before arrival in the town.

I may remark, in passing, that when he asserts that the authorities remained inactive until "alarmed by the fearful mortality" at the new port, Dr. Bentley does less than justice to Dr. Travers and the administration, since the Klang scheme, which was to prove so dramatic a success, had already been approved before the occurrence of the Port Swettenham outbreak.

Dr. Bentley also suggests that the credit for the improvement of the health of Klang may be ascribed to quinine. Quinine, as a matter of fact, was freely administered at Port Swettenham in 1901, but no public distribution of quinine as a prophylactic was undertaken at Klang.

Not a single grain during all these years was given except to my hospital and private patients actually suffering from malaria.

Dr. Bentley thinks it a "ridiculous assumption" that the high death rates of 1900 and 1901 would have remained unchecked but for the measures recorded. If he will do me the honour of reading my forthcoming book, he will find it proved (as I venture to claim beyond dispute) that in many places in the neighbourhood of Klang, so long as the Anopheline factor remains undisturbed, these high death-rates do, alas! without any "absurd fiction," continue. In view of the large increase of population, we are justified in assuming that, but for the measures taken, malaria would have claimed many more than four hundred victims during each of the years under review; and Dr. Bentley will find that the two cases of anti-malarial works, the reports of which have incurred his criticism, have been paralleled strikingly in numerous instances.

It is commonly assumed that to rid even small tropical towns of malaria by anti-malarial operations presents insurmountable difficulties, and that to attempt such a campaign over extensive rural areas would be tilting at windmills. It can be shown, however, that in the Federated Malay States planters have, quite unconsciously, been carrying out great anti-malarial works over far greater areas than Klang and Port Swettenham, for the benefit of much larger populations, at only a small fraction of the expense, and with complete success. Indeed, one cannot help suspecting that great anti-malarial works are constantly being carried to a successful conclusion by those whose last idea would be that they were carrying out great sanitary works; and in view of what has already been achieved it would be rash to deny that the future may have in store for us the final expulsion of malaria from the whole of what is, even to-day, one of the most malarious portions of the tropics.

MALCOLM WATSON.

Klang, Federated Malay States, December 27, 1910.

Studies of Magnetic Disturbances.

IN the number of NATURE for August 11, 1910, Dr. L. A. Bauer published some results of investigations of magnetic disturbances, forming an abstract of papers published in *Terrestrial Magnetism*, xv., Nos. 1 and 2.

In these papers Dr. Bauer treats a number of problems of the greatest interest for the study of terrestrial magnetism; but in my opinion there are certain points of a fundamental nature which it would be well to take up for discussion, partly because certain of his results differ considerably from those of other investigators in this field.

Dr. Bauer treats the "positive equatorial storms" of May 8, 1902, and January 26, 1903, and concludes from a mathematical analysis "that for both disturbances the systems of disturbance forces which it would be necessary to superpose upon the earth's own magnetic field were precisely of the same character as the earth's. In other words, were we to assume electric currents as constituting the disturbance systems, then, as in the case of the earth's field, the currents would have to circulate from east to west if they are positive ones and in the contrary direction—from west to east—if they are negative or such as would be produced by moving negative charges. Furthermore, for both disturbances the electric currents would have to circulate chiefly in the regions above the earth" (NATURE, *loc. cit.*, p. 192).

I am not quite sure of what is meant by the expression, that the disturbance field is precisely of the same *character* as the earth's own field. For a real similarity, which would allow conclusions to a similarity in origin of the two phenomena, we should have provided the following relation

$$\mathbf{P}=k\mathbf{T} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where $\mathbf{P}$ is a vector representing the perturbing force at a certain place, $\mathbf{T}$ is the total force of the earth's permanent magnetic field at the same place, and k is a constant. The relation (1), however, is not even approximately fulfilled for any of the principal groups of disturbances treated by Birkeland in his work, "The Norwegian Aurora Polaris Expedition, 1902–1903," not even for the equatorial storms considered in Dr. Bauer's paper, so that the similarity assumed by Dr. Bauer cannot mean that relation (1) is fulfilled.

Then when Dr. Bauer, from the similarity between the earth's own field and the field of the positive polar storms, concludes that the disturbance current systems must circulate round the earth in the same direction as that which may be supposed to produce the permanent field of the earth, this conclusion is not justified without further proof, for the two similar fields show great differences. While the forces $\mathbf{P}$ and $\mathbf{T}$ have the same direction near the equator, this is no longer the case nearer the poles, where their vertical components have opposite directions.

It seems also difficult to understand how the direction found by Dr. Bauer can be brought into harmony with his statement that the greatest part of the current is to be found above the surface of the earth. For suppose that an electric current—circulating around the earth and *above its surface*—shall produce the observed perturbing force directed towards the north, it follows from Ampere's rule that the current must pass from *west* to *east*, or in the direction opposite to that found by Dr. Bauer. So long as we regard external systems as forming the primary cause of disturbances, this result must hold even if we take into account the magnetic permeability of the earth and the effect of induced currents.

Dr. Bauer states that the disturbance systems probably always can be supposed to originate from one internal and one external current system, and for the equatorial storms he has given the mathematical method for separating the two systems.

The separation was carried out for the perturbation of May 8, 1902, and "the surprising result revealed itself that the internal currents went in the same direction as the external ones, the latter being about three times the strength of the former."

Now two systems of this kind, keeping on simultaneously, must in some way be physically connected; but it seems rather difficult to see how this connection could be produced, for, as Dr. Bauer himself rightly remarks, the internal currents cannot be induced currents. Thus it seems that merely simple physical considerations will make the result very improbable, and besides, I think that objections can be made to the way in which it is deduced.

I am not going into details regarding the validity of the mathematical method, but I am merely going to show by an example that the method used by Dr. Bauer cannot be trustworthy.

The equations for the internal systems (see *Terr. Mag.*, xv., No. 1, p. 26) are simply expressing the forces on the surface of a sphere uniformly magnetised along a certain diameter. Suppose, now, that in a plane, perpendicular to this diameter and passing through the centre of the sphere, there was a circular current concentric with the sphere and with a radius large compared with that of the sphere. The magnetic field of the current in the space occupied by the sphere would be nearly uniform, and if the sphere was made of a homogeneous material it would be *uniformly magnetised*. In other words, the equations which should express a field due to an *internal* system will in this case express a field actually caused by an *external* one. The system of equations, however, which according to Dr. Bauer should express the field due to an external system, will not even approximately be able to express an external system of the kind here supposed. I think this will be sufficient to show that the result of the separation will require further proof.

I should also like to say a few words regarding the direction of the circular current of negative corpuscles which may be formed round the earth in the plane of the magnetic equator. These currents play an important part in the kathode ray theory of Prof. Birkeland, and it is of importance that no misunderstanding should exist on this point.

Dr. Bauer arrives at the conclusion that the direction of motion of the negative corpuscles of such a current is from *east* to *west*. I have not from his short note been able to follow his argument, but a simple consideration will show that the corpuscles will encircle the earth in a direction opposite to that found by Dr. Bauer.

Suppose a negative corpuscle is moving in the plane of

the magnetic equator and describing a circular orbit concentric with the earth. The magnetic force due to the earth's magnetic field is directed towards the north, and the deflecting force must be directed towards the centre to keep the corpuscle in its orbit. Applying the well-known rule for electromagnetic deflection, we find that the corpuscle, if negative, must move from *west* to *east*.

The question regarding the simultaneity of the occurrence of the positive equatorial storms is a very important one for their physical explanation, for if it takes a time of several minutes for the pulse to travel round the earth, we must suppose that the currents producing the effects are near the earth compared with its diameter, while simultaneity of beginning would indicate very distant systems. The question of simultaneity can only have a definite meaning in the case of the abruptly beginning storms, *e.g.* the positive equatorial storms ("S" storms), and perhaps the cyclo-median storms. The polar storms, on the other hand, usually set in gradually, and near the auroral zone, where they are strongest, they are of a very local character; sudden changes at one station may have no corresponding sudden change at another; but in the case of these polar storms (cf. Birkeland's work) it is often found that the centres of disturbance fields move slowly, usually along the auroral zone.

It has usually been assumed that the positive equatorial storms set in simultaneously all round the world. The question is very carefully examined in the work of Birkeland, referred to above, for the storm of January 26, 1903. Looking at his figures, we notice that corresponding serrations show small differences in time at different stations, amounting to two or three minutes; but these *differences are equally great for neighbouring stations as for more distant ones.* The differences for neighbouring stations, which must be due to some error, are not so much caused by faults in the measurements on the time axis and the identification of corresponding points on the curves; they are rather to be considered as faults sticking to the magnetogram itself, for if we take out the time of several points of the disturbance, the time differences for corresponding points for two stations come out nearly constant.

Dr. R. L. Faris and Dr. Bauer, who have made a great amount of valuable work on the subject, have tried to eliminate the error by collecting neighbouring stations into groups, and then taking the difference between the average time of each group, and they arrive at the conclusion that the occurrence is not simultaneous. But so long as the differences between the groups are of the same order as the actual possible error of determination, it seems very dangerous to conclude to a non-simultaneity. Moreover, Mr. Krogness, by comparing the times of beginning of a number of storms at Potsdam with the corresponding times given by Dr. Faris for a group of stations on the western hemisphere, has found almost perfect simultaneity.

I think, then, that the present position of the question cannot be expressed in a better way than by the following statement taken from Prof. Birkeland's work:—

"We may conclude from this that the serrations appear simultaneously, or rather, the differences in time is less than the amount that can be detected by these registerings."

L. VEGARD.

University of Christiania, January 14.

Sir F. Galton and Composite Photography.

MAY I be permitted, as an intimate friend of many years and under deep obligations to the late Sir Francis Galton, to say a word upon a matter which is perhaps not sufficiently emphasised? I refer to his very deep and lasting interest in composite photography, and his conviction of its scientific value. He considered it capable of and well worth systematic development. This was a frequent subject of conversation between us; and he told me many times (sometimes with reference to the original contributions to photography of my brother, Colonel Stuart-Wortley) that he felt the method ought to be developed, not as a newspaper curiosity, but as a serious aid to sociology, and especially to the study of heredity.

Prof. Bowditch, of Harvard, told me that he found an unaccountable indifference on the subject in America, while he entirely shared Galton's view of its possibilities.

If anyone could be found to take up the matter seriously there can be no doubt that the pioneer would be richly rewarded. In our last talk, a few weeks before his death, Sir Francis himself told me of really sensational results from the few experiments he was able to make with a comparatively primitive instrument. For instance, he told me he had collected photographs of Queen Victoria and Prince Albert and all their children. To his great surprise, the composite gave the likeness of Princess Alice and no one else. But this was only one of many equally suggestive results.

VICTORIA WELBY.

Duneaves, Harrow, February 3.

Darwin and the Transmission of Acquired Characters.

IT is difficult to understand how anyone well acquainted with Darwin's works can come to any other conclusion than that he firmly believed in Lamarck's principle of the transmission of characters acquired by use.

Two clear examples may be cited from "The Descent of Man" (second edition):—

(1) "As the voice was used more and more the vocal organs would have been strengthened and perfected through the principle of the *inherited effect of use*" (p. 87).

(2) "There is no more improbability in the continued use of the mental and vocal organs leading to inherited changes in their structure and function, than in the case of handwriting, which depends partly on the form of the hand and partly on the disposition of the mind; and *handwriting is certainly inherited*" (p. 88).

In this matter Darwin was a true disciple of the great French naturalist to whom Prof. Judd refers with such scant respect.

E. A. PARKYN.

January 30.

I REGRET that your correspondent should imagine that, in writing the words "poor old Lamarck," I showed "scant respect" for the great French naturalist. On the contrary, I desired to express the deep sympathy I felt for this grand pioneer in evolution, who, in old age and blindness, found his splendid achievements, for the time being, discredited by the work and arguments of his successful rival, Cuvier. In the little book which has given rise to this correspondence, I have insisted upon the splendid contributions of Lamarck, not only to botany and zoology, but also to geology, and have shown how the hostility towards his work, felt at first by Lyell and Darwin, was in the end modified, and his great merits acknowledged by both of them.

I quite agree with your correspondent that the passages he quotes—and many similar ones may be cited—show that Darwin accepted the Lamarckian views as to the transmission of acquired characters to a certain extent. Darwin's tendency was, however, to insist that individual variations were always "slight" or "exceedingly little," to use his own words. In the passage to which reference has been made in the "Origin of Species," it would almost seem that he suggests that "variation" had been used in two different senses by authors—variations that could be transmitted and variations that could not be transmitted—and that he demurs to the distinction. I agree with Prof. Meldola, however, in thinking that, in all probability, the view put forward by Prof. Weismann in 1885, that *no* acquired character is *directly* inherited, never fairly came under Darwin's consideration.

In discussing questions of this kind, it is important to realise, so far as is possible, what was the current opinion at the time Darwin wrote. Now Baron Cuvier, his brother Frederick, and their followers—whose writings so greatly influenced naturalists in the early years of the nineteenth century—all freely admitted the transmission, by inheritance, of acquired characters, habits, and instincts in domestic animals like dogs; what they denied was that any of the variations so transmitted, so far as the experience of 2000 years showed, were of a *fundamental* character.

That Darwin not only accepted the idea of the transmission of acquired characters, but even speculated on

the mechanism by which it might be accomplished, is shown by his invention of the "provisional hypothesis" of pangenesis, has been justly pointed out by Sir William Thiselton-Dyer. In introducing this hypothesis Darwin wrote :—

"A multitude of newly acquired characters, whether injurious or beneficial, whether of the lowest or highest vital importance, are often faithfully transmitted . . . and we may on the whole conclude that inheritance is the rule, and non-inheritance the anomaly" ("Variation of Plants and Animals," popular edition, p. 454)

No mistake can be greater, as it appears to me, than one prevalent at the present day—namely, that by the newer developments of evolutionary theory in Weismannism, Mendelism, &c., Darwin's results are in any way superseded. On the contrary, I firmly believe that had Charles Darwin lived, no one would have more gladly welcomed these new developments than would he; for he would have rejoiced to follow the investigations of the particular *methods* by which variations are transmitted, the possible *limits* of individual variation, and the *laws* which govern their appearance.

Kew, February 1. JOHN W. JUDD.

Glacial Erosion.

THE reviewer of "Geographical Essays," by Prof. W. M. Davis, writes in NATURE of January 19 :—"Prof. Bonney's presidential address to the British Association has brought the controversy on glacial erosion to a head. It may be hoped that the authoritative and masterly statements on both sides will lead to an agreement as to the main facts, but no settlement can be expected until the arguments of those who limit the efficacy of glaciers as eroding agents have been directly answered."

I do not think that those who, like myself, hold that glaciers are powerful eroding agents would shrink for a moment from directly answering their opponents' criticisms. The most direct answer is that the deposits formed by glaciers are a direct measure of glacial erosion. I distrust all theoretical opinions based upon the study of ice as a "rock." In the early days of geological science it was difficult to convince the many that the "purling brook" and the "babbling river" had frequently excavated the deep valleys and gorges through which they run.

Do the opponents of glacial erosion really contend that the enormous deposits of boulder clay which cover such extensive portions of England, Scotland, and Ireland are not the results of glacial erosion? I say boulder clay advisedly; for there are immense deposits of laminated clay with or without boulders, sands, and gravels, which some may argue have no connection with glaciation. Here, however, I should again differ, for many years of careful study in the field have convinced me that nearly all these superficial or "drift" deposits are the result of glacial erosion.

Taking the "glacial" deposits themselves as a measure of glacial erosion, and concluding that we must look for marked effects in the areas from which the material was eroded, what do we find? We find surface lowland features, valley gradients, valley forms, and entire valleys and gorges, which are not such as are produced by the erosive action of water, rain, and frost.

The opponents of glacial erosion have been too much guided by glacial action, as now seen in such mountainous areas as Switzerland. The puny glaciers now found there cannot be compared, so far as the effects they produce are concerned, with the great confluent glaciers which once occupied the valleys.

It is a pity that in this country the conviction which so many hold concerning glacial erosion and climatal changes should have resulted in the stagnation of glacial geology as a science, for it cannot be denied that if glaciers have done very little as agents of change, there must be very little to study.

Glacialists of the active school cannot but feel grateful to such workers as Prof. James Geikie, Prof. W. M. Davies, Prof. R. S. Tarr and others, for keeping the lamp burning. R. M. DEELEY.

Inglewood, Longcroft Avenue, Harpenden,
January 18.

HARDLY anyone disputes that the passage of ice over the British Uplands swept away all the loose rock materials and redeposited them in the Lowlands as glacial drifts. The controversy is not as to the removal of the loose débris, but of the excavation of basins in fresh hard rocks. As Mr. Deeley states, the opponents of glacial erosion have written extensively; but certain serious difficulties that have been advanced by Prof. Bonney, Prof. Garwood, and others, do not seem to me to have been directly answered. I share Mr. Deeley's gratitude to the three geologists whom he names for their important contributions to glacial geology. J. W. G.

An Unconscious Forecast by Joule.

THE following remarks by Joule in his paper on the changes in temperature produced by the rarefaction and condensation of air (*Phil. Mag.*, May, 1845) are worthy of notice :—

"The beautiful idea of Davy, that the heat of elastic fluids depends partly upon a motion of particles round their axes, has not, I think, hitherto received the attention it deserves. I believe that most phenomena may be explained by adapting it to the great electrochemical discovery of Faraday by which we know that each atomic element is associated with the same absolute quantity of electricity. Let us suppose that these atmospheres of electricity, endowed to a certain extent with the ordinary properties of matter, revolve with great velocity round their respective atoms. . . ."

"The phenomena described in this paper, as well as most of the facts of thermochemistry, agree with this theory; and in order to apply it to radiation we have only to admit that the revolving atmospheres of electricity possess, in a greater or less degree, according to circumstances, the power of exciting isochronal undulations in the ether which is supposed to pervade space."

In the idea of the "atmosphere of electricity" revolving round the atom, we have the substance of J. J. Thomson's corpuscular theory, while the electromagnetic mass of the revolving "atmospheres of electricity" would certainly cause them to be "endowed to a certain extent with the ordinary properties of matter." Again, the last phrase of the extract is simply the modern idea of electromagnetic waves in the æther.

The premature birth, in this short quotation, of three of the most startling advances of modern physics is not a little remarkable. B. A. KEEN.

University College, London, January 25.

The Sailing-Flight of Birds.

IN a letter to NATURE in February, 1876, I suggested that the sailing-flight of birds and the flight of flying-fishes could be explained as tobogganing under almost perfect conditions, and in 1889 the late Duke of Argyll accepted this, in a letter to the *Spectator*, as a correct and sufficient explanation. My old friend the late Prof. H. N. Moseley, a member of the *Challenger* staff, held the view that a quivering, imperceptible to the eye, of the wings and fins was the true explanation. I do not know which explanation has been generally accepted, but I would suggest that a kinematographic picture of the flying-fish ought to settle the question finally, if it is not already settled.

I said in my letter :—"By means of a suitable mechanism for changing the inclination of the wing-planes every few seconds the sailing-flight of the albatross, I believe, might be simulated without much difficulty." Has not the aëroplane done this? R. ABBAY.

Earl Soham Rectory, February 1.

A Morning Meteor.

A METEOR equal in brightness to the Pole Star, and of much the same colour, was seen by me to fall from the southern sky at 6.25 on the morning of Friday, February 3. Its path was one of ten degrees, extended along a line midway between α Coronæ Borealis and the planet Jupiter, which at that time was shining lustrously some thirty-four degrees south, and slightly east, of Arcturus. The meteor left a steel-blue train which remained visible for six seconds. JOSEPH H. ELGIE.

72 Grange Avenue, Leeds.

INVESTIGATIONS OF PLAGUE.

THE terrible intensity of the outbreak of pneumonic plague now raging in Manchuria, and the presence of plague-infected animals within our own borders, have called forth recently a number of communications on plague in the daily press. A special correspondent in *The Times*, in two well-informed articles (December 22, 1910, and February 6, 1911), summarises the situation, and gives an admirable sketch of the principal facts concerning the modes of spread of plague. Dr. L. W. Sambon has also contributed two letters on the subject to our contemporary. He cites some interesting historical references to the preventive methods adopted during epidemics of plague, but it is a pity that he has allowed himself to fall into error on some essential points in the epidemiology of the disease. He remarks, for example, that in his belief transmission from man to man is probably more frequent than from rat to man. If Dr. Sambon bases this statement upon personal experience of epidemics of bubonic plague, it must be said that his observations are directly opposed to the experience of many competent plague workers. Dr. Ashburton Thompson, an accepted authority, has stated that in Sydney plague owes nothing of its epidemic form to contagion from the sick. The view that bubonic plague is not directly infectious is held unanimously by authorities in India.

The Advisory Committee, appointed by the Secretary of State for India, the Royal Society, and the Lister Institute, has recently issued a further volume of Reports on Plague Investigations in India (*Journal of Hygiene,* vol. x., No. 3). The volume contains a number of articles which cannot fail to interest all those concerned with plague administration. Briefly stated, it may be said that these investigations confirm and amplify the conclusions already recorded.

The first article deals with the experimental production of plague epidemics among animals. In earlier experiments guinea-pigs were used, and it was conclusively shown that epidemics could not be produced amongst these animals except when rat-fleas (*X. cheopis*) were present in the godowns or small huts in which the experiments were carried out. Gotschlich criticised these experiments on the ground that guinea-pigs, unlike rats, do not feed on the carcases of their dead companions. He believes that among rats, plague is chiefly spread by the healthy animals feeding on the carcases of those infected with plague. In order to test the validity of Gotschlich's criticism, wild Bombay rats, previously freed as far as possible from fleas, were used in the present series of experiments. The results show clearly that epidemics occur among these animals only in the presence of fleas. The Commission found no reason for thinking that alimentary infection played any part in the production of these experimental epidemics. This conclusion completely agrees with their observations on the mode of infection in naturally infected rats.

The discovery by the Commission, in the early years of their work, of chronic plague in naturally infected rats, at first sight appeared to offer a plausible explanation for the persistence of infection amongst the rat population during the off-season, and for the recrudescence of the infection when the conditions again became favourable for the epidemic spread of infection amongst rats and human beings. From the evidence available, the Commission showed considerable hesitation in ascribing to these chronic plague lesions any important part in the continuance and revival of the rat epizootic. It leaned rather to the view that the quiescent season is bridged over by sporadic cases of acute rat plague. A great deal of fresh light has been thrown upon this question in the volume under review. A much more extensive experience of chronic plague in rats in Belgaum, Poona, and Bombay has fully convinced the Commission that the pathological appearances described as chronic plague are stages in the process of recovery from the acute disease. For this reason, and because the term has been associated with theories regarding the reappearance of the rat epizootic, they regard the name "resolving plague" as more appropriate. It is evident that the epidemiological importance of chronic rat plague is on this view considerably limited, if not, indeed, abolished.

An interesting contribution to the problem of the spread of plague through districts with numerous scattered villages, will be found in this volume. The collection and arrangement of the extensive data dealing with the recent history of human plague in three districts in the Punjaub and the United Provinces were undertaken by Major Lamb, I.M.S., and a statistical analysis of the results has been made by Dr. Greenwood. While the conclusions drawn from this survey are necessarily tentative, they are of value in suggesting a rational basis for effective plague administration in the thickly populated districts in India. It would appear that reimportation of the infective agent is more likely to be the cause of outbreaks in the villages than recrudescence. Again, a study of the distribution of infected villages in maps showing the position of affairs month by month, suggests a dissemination of the infection from various centres. The statistical evidence does not point to the conclusion that the infection of a village renders it more liable to be infected during the next following epidemic.

The Commission has recorded its observations of plague during the years 1908–9 in Belgaum and Poona. The special reason for selecting these towns was that, although not far distant from Bombay, the seasonal prevalence of the human epidemics is different. It had been already shown that in Bombay the rat-flea prevalence varied at different seasons of the year, and that the season of maximum rat-flea prevalence coincided with the height of the epizootic. The intimate relation between rat-flea prevalence and the spread of rat and human plague is well illustrated in the present observations. Moreover, the interesting fact is elicited that a close connection appears to exist between the flea prevalence and the hygrometric condition of the atmosphere.

The results at Poona show that the adverse factors which combine to bring an epidemic to an end are (1) a decrease in the number of fleas, (2) a decrease in the number of rats, and (3) an increase in the proportion of immune to susceptible rats.

Mr. Sydney Rowland gives an account of his work upon plague vaccines. This contribution, which is of too technical a character to admit of a summary of its contents, describes the results of an inquiry into the immunising constituents of the *B. pestis.* The results obtained are interesting, and suggest important improvements in the method of preparation of plague vaccines.

The volume concludes with a brief statement of the provisional conclusions reached by the Advisory Committee as the result of the investigations made under their direction from 1905–9 into the mode of spread of plague in India. The Committee concludes, that in nature plague is spread among rats by the agency of rat fleas, and that, in the great majority of cases during an epidemic of plague, man contracts the disease from plague-infected rats through the agency of plague-infected rat fleas.

A perusal of this volume of reports must impress the reader with the enormous amount of work entailed in order to collect the evidence leading to these conclusions. In this country it is still little under

stood, amongst even the intelligent public, that the scientific study of disease can be effectively accomplished only at the outlay of much time and money. It is gratifying, therefore, to find that in the ably written article on the outbreak of rat plague in Suffolk, which appeared in *The Times* of December 22, 1910, the writer emphasises this point with refreshing candour. He insists that in a crisis of this kind, the effort to cope with the situation must be a national one, and that the Government must authorise the expenditure of ample funds to provide for the establishment of a staff of experienced investigators and administrators to deal with the problem. The history of the organisation of plague measures gives ample proof of the futility of adopting plans, however vigorous, that are not based on clear conceptions of the disease gained by scientific research.

WHAT SCIENCE HAS DONE FOR THE WEST INDIES.

A LITTLE more than a year ago I told in these pages, with a very sore heart, the story of what the late Sir Alfred Jones had accomplished for the West Indies by enlightened commercial methods. That chapter is unhappily closed, for no one has succeeded him. It is a more hopeful task which is now imposed upon me—to give some account of what science has done, and will continue to do. It is worth the telling, and it is more than a mere record of success, but carries a moral of far-reaching extent.

This journal, from its first number, has never ceased to preach the necessity of applying knowledge to the right conduct of human affairs. It continues to preach, and in face of the stolid conservatism of our methods, one might in a despondent mood think with little effect. But if one looks back over long periods it is not so, and the change in public opinion as represented by governmental action is little short of astonishing.

When I first became engaged in colonial work some forty years ago, the doctrine of *laissez faire* was in full swing. It was held that self-interest would determine whether an industry would succeed or fail; if it failed it deserved to do so, and another would take its place. In either case it was best to leave it severely alone. This is not the place to discuss how far such a doctrine is sound. But practically it is continually being abandoned. No industry is now free from governmental interference, and such interference is only tolerable if directed by adequate technical knowledge. Interference must always be of the nature of restraint, and at any rate theoretically one may ask whether some compensation is not justified. It can hardly be doubted that the community will have more and more to provide knowledge for industry of the kind that self-interest is powerless to provide for itself.

Mill, however, and other economists clearly saw that academic economic principles were not universally applicable to agriculture. The reason is obvious: the soil is not removable, but has to be utilised as best it can, and where it is. If it went generally out of cultivation food would fail. It was still, however, left to *laissez faire*, except in some measure in India, where the Government undertook the pioneering work in regard to tea, cinchona, rubber, and some other staples, and then left their commercial development to private individuals. In any other country but our own the work of Rothamsted would have been promoted by the State. There are undoubtedly advantages in scientific research being left unfettered to individual effort, but it is only the richest landowners, such as Coke of Holkham, and the Dukes of Bedford, who can afford to add to agricultural knowledge by experiment. The average cultivator is powerless to follow other than traditional methods. Yet it is in the interest of the community that he should do better in order that the maximum return may be obtained from the land.

When this country began to acquire tropical possessions, it was seen, however, that something more than *laissez faire* was required for their economic development. It was the Royal Society, at the hands of its president, Sir Joseph Banks, who first took the work in hand. Having the ear of the King, he was able to use Kew, which was then the private property of the Royal Family, for the purpose. The mutiny of the *Bounty* was an incident in an attempt to add to the cultural resources of the West Indies. An indirect result was the foundation of the great Dutch colonial botanical establishment at Buitenzorg. When it was decided that Kew should be maintained as a national establishment, its colonial utility was apparently one of the main reasons for the decision. In a scheme which received the sanction of Parliament the interests of "commerce" and "agriculture" were recognised, as well as the supply "of authentic and official information on points connected with the foundation of new colonies." Its functions in this respect were steadily fostered by the Hookers, father and son. The history of Kew thus affords one of the earliest instances in this country of the recognition of the duty of the State to promote scientific knowledge in the public interest. And the historic meaning of the controversies which have occasionally brought Kew prominently into public notice is simply the attempt of a policy of *laissez faire* to arrest its work.

But anything which is rooted in sound principles cannot be checked, because their necessity insists on asserting itself; and the West Indies again supply the illustration. Obviously their chief asset is solar energy. Our channel islands supply us with early vegetables. In a rule-of-three sum the West Indies stand for the channel islands of the North Atlantic shores. Alfred Jones saw this, and started a line of steamers to flood us with West Indian fruit. But this is anticipating. In the 'nineties their condition was the reverse of prosperous. And, if it is a paradox that science was indirectly the cause of the mischief, it happily was able to supply the remedy.

The Napoleonic empire left behind it two permanent legacies—the French code and beetroot sugar. When Napoleon's continental system closed the ports of Europe to British colonial produce, the import of tropical sugar was cut off. As sugar is a necessity of modern food there was the strongest impulse to find a new supply. I need not repeat a well-worn story. The chemist and the cultivator lavished all their resources on the unpromising beet, and ultimately dethroned the sugar-cane. Then came the bounties which flooded this country with sugar at scarcely more than cost price, and drove cane-sugar out of consumption.

There is a fundamental principle in agriculture: never to trust to a single crop. Ireland trusted to the potato and Ceylon to coffee, and both failed them; this was from disease. The West Indies trusted to sugar, and in their case the ruin was economic. The balance of solar energy being in its favour, on equal terms the cane should at least hold its own with the beet. But now comes the mistake and its moral. The sugar content of the cane was held to be incapable of increase; the methods of manufacture were often archaic and wasteful. Beetroot-sugar was the product of the most refined scientific skill in both directions. It was the fable of the hare and the tortoise.

In the 'nineties then the West Indies had sunk from prosperity to poverty. I heard it publicly stated at a meeting in the City of London that annexation to the United States was the only remedy. On some of the islands the peasantry were clamouring for food. And so things might have remained but for Mr. Chamberlain, who has never hesitated to cut himself adrift from hide-bound prejudices, and, regardless of them, to apply a practical remedy to an evil.

In 1897, after obtaining from Parliament some temporary relief, he sent out a commission of inquiry, of which Sir Edward Grey was a member, and to which Sir Daniel Morris, then assistant director of Kew, was attached as secretary. The Imperial Department of Agriculture was established the following year, and Sir Daniel Morris left Kew to take up the duties of commissioner. In a recent paper before the Royal Colonial Institute (see NATURE, January 26) he has given a full, and I think extremely modest, account of what he was able to achieve. That paper will speak for itself. My purpose is to show how success flowed from the patient and persistent application of scientific method.

The first thing was to see if the sugar-content of the cane could be improved. Like many other plants subjected to long cultivation, it was believed to have lost the power of producing seeds. The Pacific Islands had been ransacked without much success to find more productive kinds which might have arisen possibly by bud-variation. The White Transparent cane, which is regarded as a standard in the West Indies, yields 2¼ tons of sugar to the acre. As sugar-content varies, like everything else, in individual plants, it was suggested from Kew that an improved race might be obtained by the process of chemical selection by which the Vilmorins worked up the beet to a high standard and maintain it at it. Some success was obtained, but it was evident that it would be extremely slow. By a stroke of good fortune a more rapid method was discovered. About 1888, Mr. Bovell and Prof. Harrison noticed the spontaneous occurrence of seedling sugar-canes in Barbados. It was found that the sugar-cane did actually produce seed, though in so small a quantity that it had been overlooked. As this at once opened the door to seminal variation and selection, the attention of the Colonial Office was at once directed by Kew to the importance of the discovery. The work was vigorously taken up by Sir Daniel Morris, and from 1908 onwards seedlings have been raised on a large scale by Mr. Bovell, and continuously selected from, as well as hybridised.

The result has surpassed expectation. One seedling cane, for example, B. 3405, gave an increase more than the standard of one ton an acre, representing a net profit of £8. Dr. Watts, the present commissioner, estimates that the benefit to Antigua and St. Kitts alone would more than cover the expense of the department. Much light has been thrown on the food requirements of the cane by carefully controlled experiment. As might be expected, potash is found to be favourable, but phosphatic manures to have involved monetary loss. Dr. Watts, who has been the pioneer in the promotion of central factories, has obtained an increased production of 40 per cent. more than the "Muscovado system." Nor is this all. The pests and diseases by which the sugar-cane, like all other cultivated plants, is attacked had to be combated. The Cambridge School was drawn upon for mycologists and entomologists. Mr. Maxwell-Lefroy achieved a notable success in discovering the means of controlling the destructive moth-borer.

The upshot is that a moribund industry has been given a new lease of life by bringing scientific method to bear upon it. *Laissez faire* would say that the planters might have done it for themselves. But they did not, and, in fact, could not; a scientific campaign can no more be conducted by amateurs than a military one; the planters would not have known what positions to attack, nor could they have found the necessary men to do it nor directed them if they had.

Other industries had to be revived or created. Perhaps the most important of these was the production of Sea Island cotton with the generous help of the United States.

Lastly, but by no means least, an efficient system of rural education has been organised for the negro peasantry. I have no hesitation in saying that it is far in advance of anything which exists in the county where I am writing.

And thus Sir Charles Lucas, speaking from the perspective of the Colonial Office, is able to say that "while the eighteenth century saw the greatness of the West Indies, the nineteenth their distress, the twentieth century, he hoped, would witness their regeneration."

But this is not the end of the story. What has been accomplished in the West Indies has not been without its effect as an object-lesson elsewhere. It is to the credit of the Government of India that it has been, as already remarked, in advance of its time in pioneering work. It deprived China of the monopoly of tea, and, with the help of Kew, it has created the rubber industry of the East. But except as regards forestry it has effected little in intensive cultivation.

Canning claimed that he brought the New World to redress the balance of the Old. The Department of Agriculture for the West Indies has stimulated a new activity in the East, where some of its trained officers have found a larger scope for work. The recently published "Report of the Board of Scientific Advice for India" shows an awakeness and initiative which would have been looked for in vain a dozen years ago.

W. T. THISELTON-DYER.

PICTORIAL NATURAL HISTORY.[1]

IN this little book the experience of the expert photographer has been combined with that of the keen naturalist; the result is a volume full of interest to all lovers of the countryside. The publisher, in a special preface, directs attention to the unusually large number of illustrations, which are exclusively reproductions of photographs taken by the author. Mr. Douglas English's success with his camera has been demonstrated on many previous occasions, and in "A Book of Nimble Beasts" he certainly gives us of his best. There are a number of pictures in this volume which are probably unique, and the reader's special attention is directed to the remarkable series of photographs illustrating the life-history of the sand-wasp (*Odynerus spinipes*).

The somewhat clumsy title is apt to give the impression that Mr. English's book deals in the main with the higher animals; this is by no means the case, and, indeed, some of the best pictures and chapters deal with the lower forms of life.

The value of the illustrations is increased by the fact that all are brought closely into connection with the chapters which they illustrate, a somewhat rare quality for a book of this type.

As in many recent books dealing with nature-study, Mr. English's text consists of a series of short stories, in the course of which the characteristic habits of different animals are brought out with the utmost faithfulness, and it is a pleasure for the reviewer to record the absence of any irritating zoological errors such as

[1] "A Book of Nimble Beasts." Bunny Rabbit, Squirrel, Toad and "those sort of people." By D. English. Pp. 319. (London: Eveleigh Nash, 1910.) Price 6s. net.

are so commonly met with in natural history books for the young. For the "Book of Nimble Beasts" addresses itself to children in particular, although it will undoubtedly appeal to their elders as well.

Mr. English's style is peculiar, and, although the majority of his stories are clearly narrated and read well, he occasionally gets carried away by his enthusiasm for odd words and still more odd constructions, so as to become almost unintelligible at times, as in the following passage from the last chapter on the pygmy shrew:—"He missed both shrews, who, dashing right and left of him, entangled him in double-minded purpose. Rested the pygmy, shrunk to a rigid wisp of apprehension, ear straining, muscle-tautened, behind a flimsy screen of bark." Such passages are fortunately rare, and the greater part of his text is marked by great lucidity. It is difficult to single out any particular story, among the best are "Bunny Rabbit" and "Spinipes the Sand-Wasp."

Fox Cub. From "A Book of Nimble Beasts."

The volume is tastefully bound, and both print and paper good. The "Book of Nimble Beasts" will prove a welcome gift for many a young naturalist.

ALCOHOL AND EUGENICS.[1]

DURING the course of the year 1910 there issued from the Eugenics Laboratory of London University a memoir, entitled "A First Study of the Influence of Parental Alcoholism on the Physique and Ability of the Offspring." The conclusion arrived at by the authors (Prof. Karl Pearson and Miss Elderton) was, broadly speaking, that parental alcoholism has no such influence. A result so sensational and so opposed to the opinions of many social workers was bound to arouse a storm of hostile criticism. It weakened one of the arguments against the excessive use of alcohol, and was interpreted as being a direct encouragement of vice.

(1) Prof. Pearson divides his critics into three classes:—(1) Paid officials and platform orators of various temperance organisations; (2) economists (already answered in a supplement to the original memoir); (3) men with medical training who have written on the subject of alcohol. It is the last class who are dealt with in the first of the two papers now under consideration. Their attacks—for one can hardly apply the term criticism to much that they have written—are repulsed with considerable losses. It is shown that many of the errors attributed by them to Prof. Pearson and his fellow-author may be found in an aggravated form in the investigations quoted as evidence rebutting their conclusions. A sample of this evidence is itself examined and its complete worthlessness exposed. It consists of data obtained by Dr. MacNicholl in America, by Prof. Laitinen in Helsingfors, by Demme in Berne, also a curious piece of statistical work by Bezzola. The defence and counter-attack are admirably conducted, the writing is clear, so concise as to make a summary impossible, and as entertaining as some of the controversial essays of Huxley. Yet while according this high praise to the memoir, we regret the necessity which compelled its production and thus diverted from its proper channel of original investigation any part of the energies of the Eugenics Laboratory staff.

It is with the greater satisfaction that we turn to (2), in which the relations between extreme alcoholism, mental capacity, education, occupation, and religious profession are discussed. The material on which the discussion is based consists of the published reports of the Langho, or Lancashire Reformatory, for the years 1905–10, supplemented by special information from Dr. F. A. Gill. Particulars as to the age, number of convictions, religion, and education of 333 female inebriates were obtained this way, and of the mental condition, physical state, and conduct of 207 among them. As the authors point out, results based on numbers so small are not in any way final; they may, however, suggest a solution of the problems, or at any rate indicate methods by which they can be profitably attacked. They certainly emphasise the need for the publication of good records of individual cases.

Perhaps the most pressing of the problems referred to is the relation of alcoholism to mental defect. The closeness of the association between the two is shown very clearly in the memoir. In table x. 223 female inebriates are classified with regard to their mental state. Of these only 37 per cent. were of normal intelligence; 53 per cent. were defective mentally; 6 per cent. very defective; and 3 per cent. actually insane. It is of the utmost importance therefore to determine whether it is the intellectual deficiency which leads to the alcoholism or the alcoholism which causes the deficiency. Light can be thrown on this point by measuring the correlations between education age and mental capacity, among the alcoholists. If it is the abuse of alcohol which causes a progressive degeneration of the intellect one would expect to find a sensible negative correlation between mental capacity and age—mental capacity diminishing as age increases. No such relation has been found. Allowing for differences of education the correlation between mental capacity and age is found to be $0{\cdot}006 \pm 0{\cdot}047$, or quite negligible.

[1] (1) "A Second Study of the Influence of Parental Alcoholism on the Physique and Ability of the Offspring." By Karl Pearson, F.R.S., and Ethel M. Elderton. Eugenics Laboratory Memoirs, XIII. Pp. 35. (London: Dulau and Co., Ltd., 1910). Price 4s.
(2) "A Preliminary Study of Extreme Alcoholism in Adults." By Amy Barrington and Karl Pearson, F.R.S., with the assistance of Dr. David Heron. Eugenics Laboratory Memoirs, XIV. Pp. 55. (London: Dulau and Co., Ltd., 1910). Price 4s.

Questions of great interest are also raised in the dicussion of the relation between alcoholism and religion. Of the female inebriates in Langho Asylum quite one-half are Roman Catholics, while of the populations from which they are drawn not more than one-third are of this denomination in Liverpool or one-sixth in Manchester. These facts indicate that the Roman Catholics in Manchester and Liverpool are more given to alcoholic excess than the Protestants, and it is suggested that a reason for this may be found in a racial difference. The Roman Catholics are largely Irish immigrants, and the Irish immigrants in the industrial towns of England are not the most desirable specimens of their race. In this connection it is noted that "the Irish district of Liverpool . . . is one of the few instances in which during the last twenty years there has not been a fall in the birth-rate." Thus if alcoholism is due to an hereditary deficiency the differential birth-rate in Liverpool (and Liverpool is probably not exceptional in this respect), must lead to its propagation to a disproportionate extent.

That prostitution is in intimate association with alcoholism and mental defect is shown also in the tables of this paper. More than one-third of the whole number of women dealt with were prostitutes, but among these no greater proportion of mental defectives was found than among the remaining women. The Roman Catholic inmates of the asylum included a relatively smaller proportion of prostitutes than the Protestants, but this is due to the fact that the total proportion of alcoholists among the Roman Catholic community is greater, and not that the proportion of inebriate prostitutes is less.

Since the publication of the memoirs here described a further attack by Dr. Mary Sturge and Sir Victor Horsley, in the "First Study of the Influence of Parental Alcoholism on the Physique and Ability of the Offspring," has appeared in *The British Medical Journal* of January 14, and this has in turn given rise to letters in *The Times* from both sides. Six main errors are attributed by these critics to Prof. Pearson and Miss Elderton. Firstly, they are accused of having "committed the fundamental error of providing no adequate control of their investigations into the condition of the offspring of drinking parents." Secondly, of the unscientific use of terms, particularly of the term sober. These two criticisms cannot be considered independently. The memoir only claims to be a comparison between the offspring of sober and of alcoholic parents, therefore, if the term sober is used in a definite sense differing from alcoholic, the control provided is adequate for its purpose. A reference to it will show that the word has been carefully defined, and that the definition would be accepted by most people. The second alleged instance of the unscientific use of terms is that of the word "offspring" in the title. As the critics rightly remark, offspring might include persons of all ages, whereas only children of school age are dealt with. This would hardly, however, appear to be a justifiable ground for making such a charge, since a "first study" of a subject does not claim to deal exhaustively with the whole of it.

The third accusation is "selection by the authors of a non-representative population." It is stated that a slum population is dealt with in which 62·5 per cent. of the families were tainted with drink or in receipt of charitable aid, and that by selecting this population the authors cut themselves off from the possibility of making a comparison between the children of alcoholic and non-alcoholic parents respectively. It is a little difficult to see how the percentage to be placed in either group affects the possibility of making a valid comparison, nor is it explained how the receipt of charitable aid affects the question. With regard to the implied accusation that the data used were selected in order to give results of a particular kind, it may perhaps be remarked that as the chief difficulty in the systematic study of biological questions affecting mankind is to obtain trustworthy data on which to work, the possibility of *selecting* data on any other grounds than that of their trustworthiness does not exist, and it may be conjectured that Prof. Pearson and his colleague used all the evidence before them at the time of writing the paper.

The fourth charge is "absence of any proof of alcoholism beginning before the birth of the child." In so far as there is reason in this charge it is due to the deficiency of the data. The authors have had to make an assumption concerning the state of the parents before the birth of the children, namely, that people who use alcohol excessively after the birth of their children are very much more likely to have been similarly addicted before and at the time of the birth than those who do not. If this assumption is correct, and few people would dispute it, it follows that a classification according to the later habits would be reasonably correct also with regard to the earlier. A few parents would, no doubt, be placed in the wrong groups, and although this would tend to lessen any contrast between the offspring of the two divisions, it could not eliminate it, nor, indeed, reduce it seriously.

The fifth alleged error is "contradictory statements by Miss Elderton and Prof. Pearson concerning the children of alcoholic parents—for example, their physique, health, and higher death-rate." The contradictory statements appear to be (1) that the death-rate among the children of alcoholic parents is higher, (2) that the health of the surviving children of this class of parents seems on the whole to be slightly better than of those of the sober class. It is difficult to see in what respect the two statements are contradictory, though it may be contrary to expectation that the children among whom a larger proportion of deaths occur should be slightly healthier than the others. Prof. Pearson and Miss Elderton attribute this partly to accident, overlaying, burns, and other causes arising from carelessness, partly to want of home care, to food defects, and to other factors possibly toxic.

The sixth charge is "erroneous conclusion that the efficiency, as measured by wage-earning capacity, of an alcoholic male parent is at least equal to that of a less alcoholic male parent," which the critics describe as the chief generalisation raised by Miss Elderton and Prof. Pearson. With regard to this, we will quote the letter to *The Times* of January 16 by the latter: "Will it be believed that in a memoir of forty-six pages scarcely more than half a page is given up to the wage problem, and we distinctly state the purpose of that inquiry—namely, as a rough test, that the alcohol users were not initially, physically, or mentally, inferior to the sober." No conclusion such as that attributed to them was arrived at by them. Incidentally, the charge is made of "imagining and publishing statistical data where none exist in reality"; as an example of this we are told that Prof. Pearson has included in his tables seventeen porters, whereas only thirteen exist in reality. "He therefore has invented for this trade four imaginary individuals, though asserting throughout that he is quoting the Edinburgh figures." This is what Prof. Pearson is accused of: what he has actually done is to group as porters all those men in the class defined by the Registrar-General as engaged "in storage, porterage, and messages."

E. H. J. S.

NOTES.

For the meeting of the British Association for the Advancement of Science, which is to be held this year at Portsmouth on August 30 and following days, under the presidency of Sir William Ramsay, K.C.B., F.R.S., the following presidents have been appointed to the various sections:—Mathematical and Physical Science, Prof. H. H. Turner, F.R.S.; Chemistry, Prof. J. Walker, F.R.S.; Geology, A. Harker, F.R.S.; Zoology, Prof. D'Arcy W. Thompson, C.B.; Geography, Colonel C. F. Close, R.E., C.M.G.; Economic Science and Statistics, Hon. W. Pember Reeves; Engineering, Prof. J. H. Biles; Anthropology, Dr. W. H. R. Rivers, F.R.S.; Physiology, Prof. J. S. Macdonald; Botany, Prof. F. E. Weiss, with W. Bateson, F.R.S., as chairman of the Sub-section of Agriculture; Educational Science, Rt. Rev. J. E. C. Welldon, formerly headmaster of Harrow School.

In December, 1910, a circular, signed by Profs. R. Meldola and W. J. Pope, was sent to a certain number of the Fellows of the Royal Society inviting subscriptions to a fund for the purchase of a portrait of Sir William Crookes, by Mr. E. A. Walton, of the Royal Scottish Academy. We learn that the necessary fund, of which Lord Avebury is treasurer, has now been raised, and that the portrait will be presented to the Royal Society at a meeting of the subscribers to be held at Burlington House on February 16.

At the annual general meeting of the Royal Astronomical Society, to be held to-morrow, February 10, the gold medal of the society will be presented to Dr. P. H. Cowell, for his contributions to the lunar theory and gravitational astronomy.

As Prof. Karl Pearson is unable to lecture at the Royal Institution on March 3, the Friday evening discourse on that date will be delivered by Dr. F. A. Dixey, his subject being "Scents of Butterflies."

The Reale Accademia dei Lincei has unanimously elected King Victor Emmanuel honorary president, in recognition of his work on Italian coins, the "Corpus Nummorum Italicorum."

To the list of names of honorary foreign members of the French Chemical Society, published in our last week's issue (p. 448), should be added Profs. S'vante Arrhenius, of Stockholm, and G. Ciamician, of Bologna. In the same paragraph, for "Cannizaro" read "Cannizzaro."

The death is announced from Paris, in his seventy-first year, of Dr. Achille Kelsch, member of the French Academy of Medicine, and known by his work in epidemiology and diseases peculiar to warm climates.

The Association of Economic Biologists will hold its tenth general meeting at Birmingham, in the University buildings, Edmund Street, under the presidency of Prof. Geo. H. Carpenter, on April 6 and 7. Non-members wishing to attend may obtain particulars from the joint honorary secretary, Mr. Walter E. Collinge, 59 Newhall Street, Birmingham.

Mr. Hugh Chisholm, editor of the new edition of the "Encyclopædia Britannica"; Mr. F. W. Dyson, F.R.S., Astronomer Royal; and Surgeon-General Sir Alfred Keogh, K.C.B., Rector of the Imperial College of Science and Technology, have been elected members of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public services."

The systematic study of the megalithic and other remains in a district is a promising field of work for members of local scientific societies. We are glad, therefore, to see that in one of the papers to be read before the Cotteswold Field Naturalists' Club on February 14 at the Technical Schools, Gloucester, Dr. A. M. McAldowie will deal with "An Astronomical Study of the Long Barrows on the Cotteswolds, with Special Reference to the Meridian."

At a general monthly meeting of the members of the Royal Institution on January 6, the treasurer reported that he had received 1200*l.*, part of the legacy to the Royal Institution of the late Miss Wolfe, and 62*l.* 10*s.*, a portion of the legacy of the late Mr. C. E. Layton. The special thanks of the members were returned to Dr. J. Y. Buchanan for his donation of 100*l.* to the fund for the promotion of experimental research at low temperatures. The institution has recently received a gift of 1000*l.* from Dr. Hugo Müller.

The services rendered to forestry in the State of Vermont by Dr. Lewis Ralph Jones have been recognised in an exceptional way by the decision that the new forest reserve shall be called the "L. R. Jones State Forest." Dr. Jones was professor of botany at the University of Vermont from 1889 until he resigned the post last year to accept the chair of plant pathology at the University of Wisconsin. During this period he secured the establishment of the State forest nursery and the creation of the position of State forester, besides promoting in other ways the movement for better forest management.

The Manchester Museum has recently received, through the generosity of Mrs. Leo Grindon, the important and extensive private herbarium formed by the late Mr. Leo Grindon, who was well known in Manchester as an enthusiastic botanist and teacher, as president of the Field Naturalists and Archæological Society, and as lecturer in botany in the Medical School until its incorporation with the Owens College. The herbarium is arranged on somewhat unique lines, for each plant is accompanied by numerous coloured and other illustrations, together with much valuable printed matter in the form of cuttings from various botanical books and periodicals. The herbarium is rich in specimens of garden plants, and affords valuable evidence of the effects of cultivation on various species. The gift is greatly valued by the committee and the University authorities, not only as a specially valuable instrument in botanical teaching, but also as a memorial of a Manchester citizen who was a distinguished teacher, and inspired much affection in the wide circle of his acquaintance.

Great interest attaches to an account, by Dr. E. Trouessart, in *La Nature* of January 14, of the reported discovery in the Congo of a new mammal, which appears to be known to the natives as the "water-elephant." A herd of five of these animals was seen by Mr. Le Petit, one of two explorers sent by the Paris Museum of Natural History, on the northern shore of Lake Leopold II. Before the animals plunged into the lake, Mr. Le Petit had the opportunity of seeing that they were smaller than elephants—their height being estimated at 6 feet—with much shorter trunks, smaller ears, relatively longer necks, and apparently no tusks. Their footprints are also different from those of elephants. In an interview accorded to a reporter of *The Daily Express*, recorded in that journal of February 6, Dr. Chalmers Mitchell expressed his belief in the authenticity of the discovery, and suggested that the apparently new animal might represent

a primitive type of elephant. In this connection, it may be pointed out that Mr. Le Petit's description of the animal accords almost exactly with the restoration of Palæomastodon, of the Lower Tertiary of the Fayum, given by Dr. C. W. Andrews on p. 22 of the "Guide to the Elephants in the British Museum, Natural History." The members of that genus are there stated to range in height from 4 to 6 feet.

MR. GEORGE GREY, whose death at the Nairobi Hospital on February 3, as the result of wounds received from a lion, will be widely lamented in geographical and mining circles, as well as by his many personal friends. His exploratory work as a mining engineer is of scientific as well as commercial value, the discovery and location of the great mineral belts in North-western Rhodesia and the Katanga district of the Belgian Congo being due to him. Eleven years ago Mr. Grey mapped out a hundred copper mines from Kasanschi to the Kambone, as well as the alluvial goldfields of Rüwe, rich tin areas, and other valuable minerals, controlled by the Tanganyika Concessions Company. His work added to geographical knowledge and opened up a vast region to mining, commercial, and pastoral enterprises.

PROF. D. OLIVER, F.R.S., who completed his eightieth year on February 6, was an active contributor to botanical literature during his tenure of the position of keeper of the herbarium and library at Kew Gardens, which he vacated more than twenty years ago. His earliest paper in this connection was an article on the Indian Species of Utricularia, published in the Journal of the Linnean Society, vol. iii., in 1859. Among his numerous subsequent publications, the more important have been:—The Atlantis Hypothesis in its Botanical Aspect (1862); On the Distribution of Northern Plants (1862); The Structure of the Stem in Dicotyledons, part i. (1862); part ii. (1863); Notes on the Loranthaceæ, with a Synopsis of the Genera (1863); Lessons in Elementary Botany (1864), reprinted at frequent intervals, with a new edition in 1881; Flora of Tropical Africa, vol. i. (1868); vol. ii. (1871); vol. iii. (1877); First Book of Indian Botany (1869); The Botany of the Speke and Grant Expedition, part i. (1872); part ii. (1873); part iii. (1875); Enumeration of Plants Collected by V. Lovett Cameron, Lieut. R.N., in the Region about Lake Tanganyika (1876); List of Plants Collected by Mr. Joseph Thomson on the Mountains of Eastern Equatorial Africa (1885); with many other papers of great value on African and Arctic plant collecting especially. The excellent quality of Prof. Oliver's work is well known; the high appreciation in which it is deservedly held may be gathered from the fact that, in 1884, the Royal Society bestowed on him one of its Royal medals, and in 1893 he was awarded the Linnean medal—the highest honour it can bestow—by the Linnean Society.

AT a special general meeting of the Geological Society of London on January 25, the following resolutions were passed:—(1) That the space now occupied by the museum be made available for the extension of the library. (2) That it is desirable that the society's collections of fossils, minerals, and rocks, with certain exceptions to be subsequently specified, be offered to one or more of the national museums, provided that guarantees be obtained that the specimens will be properly registered and rendered available for scientific purposes. (3) That it is not desirable that the society should accept money for any part of the collections, or in consideration of them. (4) That the council be empowered to approach such institution, or institutions, with the view of carrying the above resolutions into effect, and that the council shall call another special general meeting to express approval or otherwise of the arrangement proposed.

A COPY of the prize programme of the Société Batave de Philosophie expérimentale de Rotterdam for 1910 has reached us. In it some forty-eight questions are propounded, and answers are invited which have necessitated research work. The gold medal of the society, or its monetary value, as the author of the selected thesis may decide, will be awarded to the reply which is selected by a general meeting of members of the society. Memoirs should reach the principal secretary of the society not later than February 1, 1912, and should be in Dutch, French, German, or English, and not in the author's handwriting. The memoirs which are awarded prizes will be printed and published by the society, and twelve copies will be offered to each author. The questions for solution range over most branches of science. A few examples of the great diversity of subjects proposed are:—an experimental research on the cause of phosphorescence, particularly in lowly organised animal forms; an experimental study of the electrical properties of some metallic alloys; and an experimental determination, carried out with the greatest care, of the atomic weight of at least one element.

SIR BOVERTON REDWOOD, chairman of the Chemical Industries Committee, Board of Trade (Exhibitions Branch), announces in a circular letter that in the British section of this year's Turin Exhibition chemical and physical apparatus will be shown in a practical and novel manner. Generally speaking, no means are provided at exhibitions for demonstrating the utility of the instruments exhibited, and it has been decided to improve upon this plan by showing apparatus as it would be used in a laboratory. Arrangements are being made by which, it is anticipated, there will be on view at Turin at least two well-equipped chemical laboratories, with such work going on as will illustrate various processes. There will be a large space available for the display of chemical products and apparatus not in use in the laboratories. In the court devoted to scientific instruments, arrangements are in hand for the display of apparatus ready for work, electric supply, where needed, being provided. The equipment of a large dark-room is under consideration, and here it is proposed to show apparatus, such as oscillographs, spectroscopes, optical lanterns, and photometers. The organisation of these exhibits has been placed by the Exhibitions Branch of the Board of Trade in the hands of Dr. F. Mollwo Perkin, under the direction of a joint subcommittee of the Chemical Industries Committee and the mathematical and Scientific Instruments Subcommittee.

SINCE the report of the British Science Guild on the synchronisation of clocks was issued, the following additional information, showing how the post office are extending their operations, has been sent to the committee by the post office representative:—The post office has had a system of synchronisation in perfectly successful operation at Leeds and Birmingham post offices for the past eighteen months. In the former case, the system has been utilised for the correction of a large four-faced turret clock, and, of course, in both cases the system controls clocks exposed, as at all post offices, for public purposes, over the posting boxes and in the public offices. The system has been so successful that arrangements are being made for the clocks at the following post offices to be similarly dealt with:—Aberdeen, Belfast, Bristol, Glasgow, Manchester, Newcastle-on-Tyne, and Liverpool.

At Aberdeen (where electric clocks on the magneta system are already installed, in which case it is, of course, only necessary to synchronise the master clocks) the synchronising system has been extended by open wires to the clocks at certain branch post offices. Further, at Sheffield an electric-clock system driven by a synchronised master clock, which controls (in addition to the ordinary public clocks referred to above) a large double-dial bracket clock fixed outside the building, has been erected. A similar system is about to be installed at Taunton. It is hoped that before very long the post office will be in a position to offer facilities to the public for the synchronisation of clocks at such rental rates as should remove the main objections which have been urged to the general adoption of the principle.

In connection with the subject of the synchronisation of public clocks, it is of interest to record that a time ball 4 feet in diameter has been provided on the summit of the dome of Messrs. S. H. Benson's building on the west side of Kingsway, and the ball is dropped at each hour by electric current. Unlike time balls which only work once a day, and require to be set up by hand daily before their fall, this one is wound up quite automatically by an electric motor shortly before each hour of daylight, and is released precisely at every hour by the Greenwich time signal. It was laid down as a condition by the architects that there should be no shock or jar occasioned by the fall, and this has been overcome by a system of counterbalancing, whereby the acceleration due to gravity is neutralised just before the ball reaches the bottom. The installation was designed by Mr. Hope-Jones, and carried out by the Synchronome Company, of 32–34 Clerkenwell Road, E.C.

A DEFINITE step towards the reorganisation of the irrigation of Mesopotamia, so long neglected, has been taken by the signing of a contract between the Turkish Government and the firm of Sir John Jackson (Ltd.), contractors and engineers, Westminster, for the construction of a large dam at the head of the Hindia canal, as reported in daily papers on January 31. This is a portion of the comprehensive scheme put forward by Sir William Willcocks, and has for its object the turning back of the waters of the Euphrates into its own bed instead of flowing down the Hindia canal, whereby a large area of country has become waterlogged. By this scheme water will be restored to the Euphrates channel, which is now dry in summer, and prosperity both on its bank and in the present marshy tracts along the Hindia canal will be greatly increased.

Of the four quarter days of the old May year, Candlemas Day, February 2, has become less marked than the rest. It would appear, however, from the following communication to *The Daily Mirror* that it is yet observed in Holland:—"Scheveningen (Holland), Thursday.—To-day is Woman's Day in Holland. Her slipper is in the ascendant. Your Dutch 'vrouw' is no believer in suffragette dreams of equality, no clamant seeker after votes for her sex. Only on one day in the year, February 2, she claims absolute autocracy. For that one day she is lord and master (baas). On awakening, 'mynheer' discovers his wife's slippers hanging conspicuously and ominously over his head. Throughout the day she flaunts her brief spell of emancipation in his face, and in the evening she gives a 'feast,' and then coquettes and contradicts and teases the very life out of him. At the end of the evening he gets his reward. The slipper domination is at an end. She acclaims him her king, her all-in-all baas, and crowns him with flowers and gladly slips back into her position as wife and lover."

THE port of Hull is shortly to have a fisheries museum, which will be appropriately situated in the western division of the city, where the population and manufactures are closely connected with the steam-trawl fishing industry; the cost of the building will be defrayed by Mr. C. Pickering. A suitable site has been granted in the new Pickering Park, and the Hull Museums Committee hope for the cooperation of the owners of fishing vessels, &c. The nucleus of the collection will be the fine collection of models of fishing methods and appliances, and preserved specimens, recently presented to the Hull Corporation by the Japanese Government. These specimens are all excellently made and are of great interest. It is suggested that the museum should illustrate the growth and evolution of the fishing and shipping industries at Hull, and fishes, both from a natural history and an economic point of view. Mr. Pickering has undertaken to help with regard to models of various types of trawlers, specimens of representative fish, &c. Such an institution should be of great educational value to Hull.

A COMMUNICATION from Sir Harry Johnston, published in NATURE of December 15, 1910, to the effect that three living okapies were then on their way to New York, is stated in the *Field* of January 28 to be incorrect. In answer to an inquiry from that journal, the acting director (Dr. H. Townsend) of the American Museum of Natural History—to which institution the specimens were reported to belong—states that no live okapies have been secured by the museum collector in the Congo. We submitted the note in the *Field* to Sir Harry Johnston, who replies as follows:—"I have nothing to add to my original statement or to the remarks on it in the *Field* of January 28 except to say that Dr. Bumpus, of the Natural History Museum, New York, did in a letter of last October give me the information regarding the capture of living okapis, which I quoted textually in my review in NATURE. I am sure Dr. Bumpus made the statement on good foundation. My review did not appear immediately it was sent in, consequently the announcement when published was a little old. What is really wanted by science is not any more mounted *skins* of okapis, but the whole carcase preserved for the careful dissection of the soft parts. This is even more important than the exhibition of live okapis as a curiosity."

THE Lord Mayor presided over a public meeting, held in the Guildhall on February 6, to consider the desirability of the systematic destruction of rats and other vermin in the interests of the public health as well as in those of agriculture and commerce. In moving a resolution to this effect, Sir James Crichton-Browne referred to the danger from plague-infected rats, and remarked that while there is no cause for panic, on account of the outbreak in Suffolk, there is cause for anxiety so long as any rats carrying the plague bacillus remain in the land. The following resolution was also adopted upon the motion of Sir Charles McLaren, seconded by Prof. G. H. T. Nuttall:—"That urgent representations be made to the Government as to the necessity for the immediate appointment of a Royal Commission for the purpose of inquiring into (1) the increase of vermin and the steps to be taken for their destruction; (2) the question of what creatures are or are not harmful to man and his industries; and (3) the safety and efficiency of the various viruses on the market and other means advocated for such destruction." It was decided to ask the council of the Royal Institute of Public Health to take steps to give effect to the resolutions adopted by the meeting.

HIS MAJESTY'S battleship *Thunderer* was launched on Wednesday, February 1, from the yard of Thames Iron Works, Ltd. As this ship is the largest floated for the British Navy up to the present, the builders have to be congratulated on the enterprise and courage which has enabled them to overcome the difficulties inherent to the building of ships on the Thames. When finished, the new ship will have a displacement of 22,500 tons; her length is 545 feet and her breadth 88 feet 6 inches. Parsons' turbines, to give a speed of 21 knots, are being constructed at the builder's works at Greenwich. The launching weight of the vessel and cradles was about 9600 tons, and the ways were so designed as to keep the pressure under 2 tons per square foot. The inclination of the ways was 1 in 16, and about 10 tons of tallow, together with oil and soft soap, were used for lubrication. The launching operation passed off without hitch of any kind, and the vessel was immediately towed down the river to Dagenham, where the firm have had constructed a new ferro-concrete jetty for the purpose of enabling the ship to be finished.

A REPORT has just been published by Mr. F. Palmer, chief engineer to the Port of London Authority, in which is described a very comprehensive scheme for the improvement of the Port of London. In a summary of the report, *Engineering* for February 3 states that the net tonnage entering the Port of London has increased in recent years at the rate of about three million tons every ten years. The maximum size of vessels using the port has increased from 10,000 to 14,000 tons. The new scheme in its entirety will cost about 14,500,000*l*., and provides, among other improvements, for four new docks and rearrangements and reconstruction for those at present in existence. The depth of water in all will be increased, and from the Millwall Docks seawards there will be a channel 600 feet wide, giving 20 feet at low tide and 41 feet at high tide. Just above the Albert Docks this will change to a channel of corresponding width, but of 10 feet greater depth, while a little lower it opens out to 1000 feet in width. As all the best docks at present are fully occupied, but little additional tonnage can be attracted except by the provision of new or improved facilities, and there seems little doubt that many of the suggested improvements will be carried out in the near future.

IN *The Times* of February 3 a correspondent says that another attempt to cross the Atlantic Ocean by airship will be made early this year. The enterprise is being promoted by a German syndicate, and it is reported from Kiel that the airship, named the *Suchard*, is practically complete, and will, after trials, be shipped to St. Vincent, Cape Verde Islands. The *Suchard* differs essentially from the Wellman airship. The gas envelope is constructed more or less on the lines of the Parseval dirigible, but it is of stouter material. In length it is 195 feet, and its greatest diameter is 55 feet. The cubic capacity is 9400 cubic metres, and an abnormally large air ballonet is fitted. Care has been taken to devise a system of balancing which will keep the vessel as nearly as possible at a uniform height. The motive power will be supplied by two petrol engines of 200 horse-power, mounted in a boat slung beneath the envelope. In the event of mishap to the envelope, necessitating its being cut adrift, the motors can be employed to propel the boat. The entire power plant and all the stores are to be placed in this boat. A light upper deck or platform is situated above the boat of the *Suchard*, which gives access to the envelope. The promoters claim that they will be able to cross the Atlantic in three ways, namely, by the dirigible, with the engines running and the trade winds helping; by balloon, in the case of the failure of the engines; or by motor-boat.

AN article by Prof. G. H. Bryan in the *Cornhill Magazine* for February deplores the loss of life by aëroplane accidents, and suggests that the trial-and-error methods by which the development of aërial navigation has been accomplished do not provide the quickest or the best means of solving the problem of stability or of producing machines by which the difficulty of flying will be reduced to a minimum. "The difficulty of flying straight," he remarks, "has been overcome, not by a complete investigation of the problem of stability and the consequent construction of stable aëroplanes, but by aviators learning to balance themselves on more or less unstable machines." Work is wanted in the laboratory, and experiments with models in the air, to provide the material required for the mathematical solution of the problem of maintaining equilibrium in the air under various conditions. While many valuable money prizes are offered for successful flights, practically no encouragement is given to any mathematical or other purely scientific investigator to devote one or two years of fairly continuous work to the study of the stability of motion of an aëroplane. There are plenty of mathematicians who are admirably equipped for such an investigation, but the pressure of their everyday duties, or the necessity of earning a modest livelihood, prevents them from undertaking the work except in their spare time. Prof. Bryan himself, working with Mr. Harper, finds that in ordinary circumstances "a machine is less liable to overturn by pitching, but some machines are more liable to overturn sideways when gliding downwards than when flying horizontally." He considers that most machines at present in use are more or less unstable laterally, and that the methods by which progress has been achieved have involved—to use the title of his article—unnecessary "Wastage of Men, Aëroplanes, and Brains."

THE report of the Public Health Committee of the London County Council, containing the report of the medical officer of health of the county, Sir Shirley Murphy, for the year 1909, has recently been issued. It contains a mass of statistical matter of the utmost value, as well as several special reports by the assistant medical officers on subjects of importance in public health. Of the latter, Dr. Hamer's on nuisance from flies and on the seasonal prevalence of vermin in common lodging-houses is of particular interest. A census of flies in selected localities, the species to which they belong, their seasonal prevalence and relation to intestinal diseases, are discussed.

AN article referring to the Chinese tree originally named *Cupressus Hodginsii*, by Mr. S. T. Dunn, appears in *The Gardener's Chronicle* (February 4). Dr. A. Henry, in consultation with Mr. H. H. Thomas, announces that from an examination of further material they make it the type of a new genus, Fokienia, intermediate between Cupressus and Libocedrus. It agrees with Cupressus in the shape of the female cones, and is similar to Libocedrus in the unequally-winged seeds and general characters of the foliage. Another announcement in the same issue relates to the discovery in a Dutch nursery of a fertile sport of the maidenhair fern *Adiantum Farleyense*, often mentioned for its sterility, *i.e.* non-production of spores. The new variety is said to be superior in other respects, inasmuch as it thrives at a lower temperature and bears the petioles more erect and rigid.

The difficulty of producing definite proof even for elementary physiological principles is exemplified in the two articles on the translocation of carbohydrates in plants contributed by Mr. S. Mangham to *Science Progress* (October, 1910, and January, 1911). Formerly the opinion was generally accepted that, while albuminous substances pass through the sieve-tubes, the carbohydrates travel chiefly, if not entirely, through the parenchymatous cells of the vascular bundle. In 1897 Czapek enunciated the view, which is here affirmed, that the sieve-tubes furnish the path for rapid translocation of the assimilates as a whole. The problem is discussed both with regard to the structure of the conducting tissues, more especially of the small veins in the leaf, and the results of physiological experiments. The weightiest arguments are derived from the interpretation of Schubert's examination of the leaf-veins and the author's experiments for tracing the sugars in the tissues by the formation of osazones. The latter method is only briefly indicated, but further details of the process and results are promised; meantime, the author is justified in stating that he has furnished strong evidence in favour of Czapek's theory.

We have received the Almanac for 1911 published by the Survey Department of Egypt. It has increased in size, and contains a large amount both of statistical and general information concerning Egypt and the Nile basin. Much information relating to such important matters as taxation, areas of jurisdiction, &c., which is not always readily accessible to the public, is here included.

In the report upon the rains of the Nile basin and the Nile flood of 1909, published by the Survey Department of Egypt, Mr. J. I. Craig gives full details of the rainfall and its effect on different parts of the river system. He points out that certain anomalous variations of the level of Lake Victoria in 1908 have been definitely traced to instability of the gauge at Jinja, and are not to be connected with possible crustal movements. The number of stations has increased, there being now 96 in Egypt and the Sudan, while data from 121 other stations in surrounding regions are utilised. In a final chapter he summarises recent investigations into the possibility of predicting the character of the flood.

In the January number of the *Geographical Journal* Prof. T. Park describes the area affected by the Tarawera eruption in New Zealand in 1886, its erosion since that date, and the development of new vegetation. The sheet of grey ash which then covered the dissected tableland on the shores of Bay of Plenty has now been deeply scored by rain, and many points of interest, such as the distribution of the black andesitic ash, may now be seen. Since 1890 the growth of vegetation, mainly bracken, tutu, veronica tree fern, blue gum, and acacia, has been rapid, some of the gum trees being now more than 30 feet high.

To the Bulletin of the St. Petersburg Academy of Sciences of December 1, MM. Dudetzky and Weinberg communicate a short paper on the microstructure of hailstones. These were collected during a thunderstorm at Tomsk (Siberia) on June 12, 1910, were mostly spheroidal in form, and generally 7 to 10 mm. in size. Their concentric spherical layers were alternately opalescent and transparent, and divided according to the rays by a quantity of air-bubbles, frequently oblong in shape. Many of the stones consisted only of one layer, sometimes quite transparent, in other cases milky. An interesting peculiarity presented itself in some of the stones, formed of several spherical layers, viz., the eccentricity of the milky central grain. This occupied a lateral part of the hailstone, and often formed but part of a sphere. In the stones examined it was difficult to indicate any relation between their crystalline and physical structure. The only fact that could be drawn from the visual study of the images of the thin plates on a screen was a certain enlargement of the crystalline grains with distance from the centre of the central layer.

According to a paper by Dr. L. A. Bauer in the January number of the *American Journal of Science*, it is proposed to take observations of the value of the gravitational acceleration on board the American magnetic ship *Carnegie* during her future voyages, beginning at Cape Town in April next. The method to be adopted is that suggested by Guillaume in 1894, and used on land by Mohn and at sea by Hecker. It consists in the observation of the height of the barometer and the boiling point of water with mercury thermometers of special construction, or with resistance thermometers. The principal difficulty in obtaining accurate results is the "pumping" of the barometer owing to the motion of the ship, and this, it is hoped, will be overcome by the construction and mounting of the instrument. The barometers and thermometers are to be compared at intervals with standard instruments, and observations in port are to be made on land and on water, and are to be compared with the results of pendulum observations wherever it is possible. By these means Dr. Bauer hopes to secure results free from the objections which can be urged against those of Hecker.

The new convertible Balopticon lantern, of which a catalogue has been issued by the Bausch and Lomb Optical Co., Thavies Inn, London, E.C., is designed for the projection of lantern-slides by transmitted light, opaque objects by reflected light, and for microscopical and vertical projection by the addition of the necessary attachments. The apparatus appears to be very ingeniously devised, as by its aid almost any projection work may be carried out efficiently that would otherwise require much larger and more complex arrangements. It must not be forgotten, however, that the brilliancy of the picture to be obtained with any projection apparatus depends primarily on the power of the source of light, so that the illuminant, particularly for opaque objects, should be an efficient one. In the present instance this point has not been overlooked, and as, in addition, the optical parts are of a high order, the results to be obtained are in every way satisfactory. Each one of the above-mentioned methods of projection may be obtained almost instantly as required, so that for lecture purposes, where objects of a varied character are to be shown, the apparatus can be used with ease.

The *Builder* for January 27 contains an interesting account of a method of strengthening a bridge by means of sheathing the steel trestles with reinforced concrete. The bridge operated on is that carrying the Wabash Railway over the River Missouri. Originally designed for the moving loads prevalent at the time, the trestles were quite inadequate for modern traffic requirements. After preliminary experiments, all the columns have been converted into octagonal reinforced concrete columns by applying concrete embedding a spiral coil of No. 6 American gauge wire wound with a pitch of 2 inches. The column bases consist of a rectangular concrete block reinforced by a network of steel rods near the outer surfaces. The struts bracing the four columns in each tower have been cased in concrete, the concrete being reinforced by eight half-inch rods, around which is a wrapping of wire netting. The connections between columns and struts are stiffened by reinforced concrete brackets. The concrete used was mixed in the proportions of one part Portland cement to

three parts of coarse sand. Tests conducted at the University of Illinois show that the reinforced concrete column possesses about double the strength of the plain steel column prior to reinforcement.

THE London representative of the firm of E. Merck, of Darmstadt, desires us to say that the "Index" referred to last week (p. 453) can be obtained at the address of the London house, 16 Jewry Street, E.C., and that the price of the book is 6*s.* 6*d.*

THE first number of *The Irish Review*, a monthly magazine of Irish literature, art, and science, will be issued next month. The review will be for Ireland what such periodicals as *The Quarterly Review, The Edinburgh Review, Le Mercure de France*, have been for neighbouring countries. It will compete with no existing periodical, and will publish in its literary pages nothing of merely ephemeral interest. In each number will be an authoritative article on a subject of scientific or economic research as applied to Ireland.

MESSRS. FLATTERS AND GARNETT, LTD., 32 Dover Street, Manchester, have issued two new catalogues. One provides interesting particulars of a series of new lantern-slides, and is supplementary to the catalogue of lantern-slides published by this firm in November, 1909. Attention may be directed specially to the slides illustrating plant associations, by Mr. W. B. Crump; bird photographs from recent negatives; and the reproduction and development of *Pinus sylvestris.* The second list deals with optical lanterns and accessories. One novel item in the latter is a combined lantern-screen and stand which can be erected in two minutes.

OUR ASTRONOMICAL COLUMN.

NOVA LACERTÆ.—In his note to the Academy of Sciences (*Comptes rendus,* January 23) describing the spectra of Nova Lacertæ secured at the Meudon Observatory on January 15, M. P. Idrac directs attention to the great width and the structure of the bright hydrogen lines.

Each of the hydrogen lines $H\beta$–$H\zeta$ extends over about 40 Angströms, and in $H\beta$, $H\gamma$, and $H\delta$ there are strong maxima at about 12 Angströms from the centre of each band towards the red; the photograph is probably too weak to show them in $H\epsilon$ and $H\zeta$. The band at λ 464 is as strong as the hydrogen lines, and has hazy borders, its width being about 50 Angströms; there is also a bright line at about λ 437.

The spectra secured are too narrow to show absorption lines definitely, but one is suspected on the more refrangible side of $H\gamma$. Altogether, the spectrum appears to be of the nova rather than of the long-period variable type.

MARS AND ITS ATMOSPHERE.—A number of drawings of the surface features of Mars, reproduced and described in Circular No. 5 of the Transvaal Observatory, are of interest, inasmuch as they represent the observations of two unbiassed observers using a 9-inch refractor under favourable conditions. The observations were made during the latter part of 1909 by Mr. Innes and Mrs. H. E. Wood, and are depicted on forty-two separate discs; Mrs. Wood also contributes a composite map embodying the details seen on her separate sketches.

Mr. Innes saw many fine and elusive shadings, but no "canals," in the usual acceptance of the word, were seen by him. He directs special attention to the two conjugate, diametrical, double canals usually shown crossing Hellas, and states that he was never able to see more than a curious curved shading. On the other hand, Mrs. Wood, in her drawing of October 25 (No. 40) and on the composite map, shows Peneus and Alpheus in their conventional forms.

In Bulletin No. 180 of the Lick Observatory Prof. Campbell and Dr. Albrecht describe the results secured in an attempt to obtain evidence for water vapour and oxygen in the Martian atmosphere by the broadening or duplication of the corresponding terrestrial lines on large-dispersion spectrograms. As red-sensitive plates are now readily procurable, it was expected that this application of the Doppler-Fizeau principle, which occurred to Prof. Campbell in 1896, might prove fruitful. Spectrograms were secured, some under excellent conditions, in January and February, 1910, with a specially designed grating-spectrograph made at the observatory, and the displacements of the lines carefully measured.

The results indicate that the amount of water-vapour existing in the planet's atmosphere on February 2, 1910, was certainly less than one-fifth that existing above Mount Hamilton, where the air temperature was 0° C., the relative humidity was 33 per cent., and the absolute humidity was 1·9 grams per cubic metre; the zenith distance at mid-exposure was 55°. The amount of oxygen above unit area on Mars was, apparently, also small as compared with that in the earth's atmosphere.

COMETARY THEORIES.—In No. 4466 of the *Astronomische Nachrichten* Messrs. Roe and Graham, of the Syracuse University, suggest a new theory of comets which they believe to be based on phenomena in accordance with modern mathematical physics. Briefly, it is that the sun, as an intensely heated body in which violent chemical action is taking place, emits abundant streams of negative electrons, and so acquires a positive charge. Other bodies, such as the earth and comets, will act similarly under the action of some agent intimately associated with the ultra-violet light radiations which they receive. As the comet approaches the sun, the positive charge will tend to increase, and the mutual repulsion of the charged particles will overcome the relatively small cometary gravity, thus producing streamers away from the comet and the sun. Various associated problems are discussed in the paper, and various desirable lines of research are briefly enunciated.

In No. 4468 of the same journal Prof. Eginitis also discusses the physical constitution of comets as exemplified by the phenomena attending the recent passage of Halley's comet. After May 21, 1910, the tail appeared to be much brighter than before, and Prof. Eginitis attributes this to the fact that then we were looking at it by directly reflected solar light—the side illuminated by the sun's rays was exposed to us. Therefore, he argues, the material composing comets is but slightly luminous, and we only see it clearly when it is acting as a reflector of the solar light. From this it follows that the physical constitution of comets is not purely gaseous—the comet is a mixture of gas with solid corpuscles.

POLARISATION IN THE SPECTRUM OF *o* CETI.—When, in 1898, it was found that the bright $H\gamma$ line in the spectrum of Mira was triple, it was suggested that the phenomena might be due to the Zeeman effect produced by magnetic activity in the star. Polariscopic observations were not then possible, and the faintness of Mira in 1899 defeated the preparations made for the maximum of that year.

During the maximum of 1909 preparations were again made at the Lick Observatory, and photographs were secured, but no definite general conclusion accrued. As Dr. Wright explains, in Lick Observatory Circular, No. 183, the whole problem is hedged with grave difficulties, chief of which is that introduced by the possibly considerable changes of direction of the magnetic field in the star. All that can be deduced definitely from his observations is that they show that the multiple character of the lines is not due to a magnetic field maintaining a constant direction throughout the source.

THE EARTH'S ACTION ON SUNLIGHT AND HEAT.—Mr. James D. Roots sends us a pamphlet in which he enunciates a theory to answer the question: "What Becomes of the Sunlight and Heat Absorbed by the Earth?" Mr. Root believes it is converted to "radio-activity, and then by stages of change to electric current," which leaves the earth at the poles, completing a continuous cycle sun to earth, earth to sun. The story is not so continuous, and often consists of such statements as "The main currents rotate the earth," but it is reassuring to learn that Sir J. J. Thomson, in one passage of his "Electricity and Matter," "almost grasps the truth."

EXPERIMENTS ON COAL-DUST EXPLOSIONS.[1]

A PRELIMINARY record of experiments made with coal dust, and other work of various kinds, carried out by a committee of colliery owners on behalf of the Mining Association of Great Britain, has lately been published in an elaborate and splendidly illustrated volume.

In the introductory chapter the committee quotes the remarks of John Buddle (1803) regarding "the shower of red-hot sparks of the ignited dust which were driven along by the force of the explosion," and those of Faraday and Lyell (1884): "There is every reason to believe that much coal gas was made from this dust in the very air of the mine, *by the flame of the firedamp which raised and swept it along*, and much of the carbon of this dust remained unburnt from want of air."[2] A general list is then given of those who have taken part in the investigation since 1875 (not 1870 as stated), regardless of chronological order, and reference is made to the opinions expressed by the Royal Commission, 1891–4, and of a committee consisting of the members of the Royal Commission of 1906, which is still in existence, and an advisory board associated with it, to the effect that experiments with coal dust should be made on a larger scale than any hitherto undertaken. The circumstances which induced the Mining Association of Great Britain to undertake to find the necessary funds, which were estimated at 10,000*l*., are also described.

The committee illustrates in cross-section some of the different galleries in which previous coal-dust experiments were made, as well as those now being employed in France and England, and finally sums up the results of the work of its predecessors as follows:—"These galleries or tubes have in no instance been of sufficient size to allow of the conditions prevailing in a mine being reproduced." "Neither were they of sufficient length to obtain the development of explosive force nor of sufficient strength to resist the latter if obtained. The inflammability of coal dust had been demonstrated by Faraday."

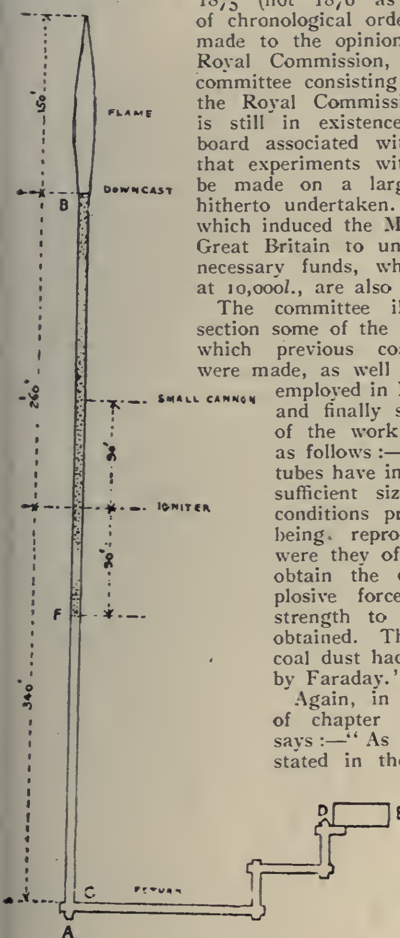


FIG. 1.

Again, in the first paragraph of chapter iii. the committee says:—"As has already been stated in the Introduction, one of the most important objects of this inquiry has been to demonstrate as conclusively as possible the great danger that exists from the presence of coal dust on the roadways of a mine, and by ensuring the absence of gas to definitely establish the fact that it is not essential that firedamp in addition to coal dust should be present for an explosion to be propagated."

These historical references are singularly curt and inexact. Whatever may have been the actual motive that dictated them, they have the appearance of being an attempt to set aside any possible claim to having done really useful work by those who occupied the field in the interval between the time when Faraday showed by an experiment that flame is enlarged when coal dust is allowed to fall upon it and the present day. They appear to simulate ignorance of the fact that the dangers due to the presence of coal dust, both with and without the simultaneous presence of firedamp, was conclusively proved long ago—the explosion at Altofts Colliery in 1886 (Proc. Roy. Soc., vol. xlii. 1887) having been, itself, the culminating proof on a gigantic scale of the second alternative.

Does the British colliery owner, as personified in the committee, hope, by thus assuming the airs and manners of Sir Oracle to conceal his own laches in having hitherto, with few exceptions (of whom the late Mr. Archibald Hood may be taken as the most brilliant example), contributed nothing towards the solution of the coal-dust question, but contented himself with classifying those who were bearing the burden and heat of the day as faddists and theorists?

One can understand the grief and dismay of the French Government engineers who, by their inept criticism of the present writer's experiments and conclusions and of his description of Penygraig explosion (1880) (Proc. Roy. Soc., No. 219, 1882), and by their own abortive experiments with coal dust, lulled themselves and their fellow-countrymen to sleep twenty-eight years ago, on being rudely awakened by the Courrières explosion, with its holocaust of more than 1100 men.

One can sympathise with the confusion of the United States Government engineers at being caught lagging in the rear of an important movement.

But it is difficult to understand why one's own countrymen should be less generous than were the Prussian Government engineers, who showed Sir W. Thomas Lewis and the present writer a most violent explosion of air and coal dust, "without any admixture of firedamp," in their gallery at Neunkirchen on October 25, 1884, frankly avowed that they drew their inspiration from the present writer's earlier work, volunteered the statement that he was the inventor (*sic*) of the method of proving the explosiveness of coal dust in an experimental gallery, and added that his gallery of 1880–1 (for which the Government Grant Committee of the Royal Society provided the funds) had served as a model for their own.

These blots upon a work that is otherwise admirable in many respects ought to have been avoided at every hazard. There was plenty of room for the colliery owner to come in with his gigantic apparatus to demonstrate the dangers of coal dust to himself, his officials, and the community in general, without having to push others aside in the process.

The demonstrations with the Altofts apparatus are so overpoweringly convincing that, in the opinion of the present writer, the Government ought to make it obligatory on the part of everyone who holds a mine manager's certificate to have seen them. They constitute, as the committee itself properly observes, the most important function of the apparatus, before which all the other questions which it proposes to investigate pale into obscurity.

The second chapter is devoted to a description of the experimental gallery, the method of preparing the dust, and the means of raising and igniting it.

That part of the apparatus (Fig. 1) in which the explosions are effected is a straight tube AB, 7 feet 6 inches in diameter, made up of the outer shells of steam boilers with their ends abutting against, and fixed to, each other, 600 feet long, open at one end, closed at the other, and with a branch CD, 6 feet in diameter, also made up of boiler shells, which extends at right angles from the closed end of the tube AB to an exhausting ventilating fan at E.

The branch CD is bent four times at right angles to itself, and is provided with two relief valves at each bend, one at A and another opposite the junction at C, making ten altogether, which open when an explosion takes place, and thus protect the fan from injury. A segment in the bottom of the explosion gallery, with an arc 5 feet wide, filled with concrete, constitutes a level floor on which a line of rails of 25-inch gauge is laid. The rails rest on sleepers 3 feet apart, embedded in the concrete. Five rows of wooden shelves, 5 inches wide by $\frac{3}{4}$-inch thick, fixed on iron brackets, extend along each side of the gallery from

[1] "Record of the First Series of the British Coal Dust Experiments, conducted by the Committee Appointed by the Mining Association of Great Britain. A Record of the Experiments carried out during 1908 and 1909 at the Altofts Experiments Station." Pp. viii+212. (London: The Colliery Guardian Co., 1910.) Price 10*s*. net.

[2] The italics are the reviewer's.

A, which is called the downcast end, to F, a distance of 350 feet, which is shaded in the sketch.

For seven minutes before, and also while the experiment is being made, the fan draws air into and through the gallery from its open end at the rate of between 50,000 and 60,000 cubic feet per minute.

The dust employed in all the earlier experiments up to the twenty-fourth was obtained from the colliery screens, but in all subsequent experiments (exclusive of some made with dusts from other localities and from abroad) it has been produced by grinding nut-coal from the Silkstone pit of Altofts Colliery in a disintegrator. The composition and degree of fineness of the latter are as follows:—

		Intercepted by	
		100 mesh	7·25
Moisture...	3·21	... 150 ,,	7·50
Volatile matter	33·68	... 200 ,,	3·00
Fixed carbon...	57·60	... 240 ,,	9·25
Ash...	5·51	... Finer	73·00
	100·00		100·00

The quantity employed in an experiment is 1 lb. per linear foot, or 0·39 oz. per cubic foot of air-space. It is thrown on to the shelves by hand.

It is usually ignited by firing a charge of 24 oz. of gunpowder, tamped with 8 inches of dry clay, from a hole, 2 inches in diameter by 2 feet 9 inches deep, in a cannon, called the igniter, placed in the middle of the floor, pointing upwards at an angle of from 32 to 35 degrees, facing towards the mouth of the gallery and at a distance from it of anywhere between 260 and 360 feet, as the case may require. But when it is desired to take special pains to secure ignition, as, for example, when visitors are present, a second small cannon charged with 4 oz. of gunpowder and 3 inches of clay-tamping, placed at a point 90 feet nearer the open end than the igniter in such a position that it cannot ignite the dust, is fired first so as to raise a cloud of dust, which the air-current then carries inwards towards the larger cannon. Both cannons are fired electrically, the smaller one two seconds before the larger.

The discharge of the smaller cannon drives a cloud of dust 4 or 5 feet long out at the open end of the gallery; that of the larger cannon drives out a similar cloud between 30 and 40 feet long. Then comes a rush of dust, followed immediately by flame, which shoots out to an average distance of 156 feet, in some cases to 180 feet, accompanied by a loud report, which is said to be heard at a distance of 3½ miles. Finally, the flame rises up and ramifies into the cloud of coal dust which preceded its first appearance, now floating in the air above it, and a great volume of smoke and dust drifts slowly away.

In Fig. 2 the open end of the gallery is seen at the right-hand side; the white areas immediately in front of it and in the smoke-cloud represent the flame. Fig. 3 is a nearer view of the mouth of the gallery when an explosion is in progress.

All these phenomena, without exception, are identical, except as regards magnitude, with those produced with mixtures of coal dust and pure air, "without the presence of inflammable gas," in the Royal Society gallery in 1880–1, in the Prussian gallery at Neunkirchen in 1884 (see later), and in Hall's experiments in the Big Lady pit in 1890, all of which the present writer has seen, as well as the Altofts experiment.

On the other hand, the Altofts gallery is itself a mere toy compared to one of the galleries, 5300 feet, or nearly twenty times as long, in Altofts Colliery, through which the explosion sped in a straight line in 1886; and as the committee's own experiments, described in part ii., chapter ii., have shown that the pressure and velocity increase rapidly with the length strewn with coal dust, it seems somewhat absurd of the committee to propose to make minutely correct observations of pressure, velocity, temperature, the size, shape, and composition of particles of coked dust, and so on, with the idea that these observations will be of some practical value in solving questions relating to colliery explosions, which they rather indefinitely class under the far-reaching title of "chemical and physical phenomena."

A mine-waggon weighing 4½ cwt., placed on the rails at a distance of 6 feet inside the gallery, ricochets along the surface of the ground in front to a distance of several hundred feet when the explosion takes place. A similar experiment was witnessed by Sir W. Thomas Lewis and the present writer at the Prussian gallery at Neunkirchen, referred to above. The explosion itself is described in NATURE of November 6, 1884, p. 13, as follows:—"*Notwithstanding the entire absence of firedamp*, there was a true explosion of the most violent kind, and the clouds of afterdamp which streamed from every opening darkened the air in the neighbourhood of the gallery for two or three minutes."[1] A mine-waggon loaded with iron so as to weigh 15½ cwt., placed at the entrance to the gallery, was driven up an incline rising at an angle of 4° to a

FIG. 2.—Flame issuing from Downcast End.

distance of 23 feet. The quantity of gunpowder used in the shot-hole was only 230 grams, or practically half a pound.

The observations (p. 21) regarding the position of deposits of coked coal dust on timbers fixed in the gallery to represent props in a mine are for several reasons, one of which is the baffling effect of the ventilating current, of no practical value as a means of throwing light upon the point of origin of an explosion in a mine.

Chapter iv., "On the Chemical Analysis of Coal Dust," and chapter viii., entitled "Laboratory Investigations," are intensely interesting and instructive, principally on account of the numerous, carefully thought-out devices described in the latter for obtaining, collecting, and analysing the volatile constituents of coal, and if published as a separate pamphlet would form a valuable addition to the library of everyone interested in the analysis of mineral fuels. The methods of estimating volatile matter, ash, and fixed carbon are practically the same as those recommended by Dr. Pollard in the Memoirs of the Geological Survey.[2]

In chapter v. the instruments intended "for investigating the mode of propagation of coal-dust explosions" (which, stated in plainer language, means those for measuring pressure, velocity, and temperature, and for

[1] The italics are the reviewer's.
[2] The Coals of South Wales (1908), p. 7.

collecting samples of the afterdamp), are described and illustrated. One of two methods of ascertaining velocity, which appears to be fairly satisfactory, consists in fixing strips of tin-foil, 4 inches long by ½ inch wide, in a horizontal position inside the gallery at intervals of 50 feet from each other, which, on being melted successively by the passage of the flame, break electric contacts in the same order, the results being recorded by an instrument of similar type to that usually employed for similar purposes.

The manometer is ingenious, and appears to work satisfactorily, but takes no account of negative pressure. It should be supplemented by adding another much more delicate instrument for the latter purpose.

No satisfactory instrument for recording temperature instantaneously has yet been devised. On the other hand, the contrivance adopted for collecting samples of afterdamp automatically is simple and efficient.

When there are obstacles in the form of "props and bars" (presumably of similar dimensions to the timbers employed for supporting the roof in the roadways of mines) fixed at a distance of 9 feet apart in the gallery, the pressure and velocity of the explosion are found to vary more or less directly with the length of gallery strewn with coal dust, through which the flame has to travel between the igniter and the mouth. In giving rise to greater frictional resistance, these obstacles apparently raise the pressure and temperature of the air advancing towards and rushing past them, and thereby promote a more rapid and intense combustion of the coal dust.

Two manometers, A and B, fixed at distances of 50 and 150 feet respectively from the mouth of the gallery, recorded the following maximum pressures per square inch when the point of ignition was at the respective distances from them shown in the following table:—

Number of experiment	B: Distance from igniter ft.	B: Pressure lb.	A: Distance from igniter ft.	A: Pressure lb.
54	125	35	225	50
53	150	38	250	65
62	275	43	375	92

The highest pressure recorded, viz. 100 lb. per square inch, appears to have been in experiment 55, when a length of 150 feet next the mouth of the gallery was free from dust, the next following, 275 feet, strewn with dust, and the igniter was fired at the innermost end of the dust zone, that is to say, at a distance of 325 feet from the mouth, with presumably thirty-six sets of "props and bars" forming obstacles in the path of the explosion. The manometers were in the same positions as in the other experiments recorded above and below.

When there are no obstacles the pressures are much smaller, and appear rather to decrease than to increase with distance of travel, as shown below:—

Number of experiment	B: Distance from igniter ft.	B: Pressure lb.	A: Distance from igniter ft.	A: Pressure lb.
50	125	11·9	225	8·75
51	150	9·8	250	8·3
110	275	8·5	375	9·2

The records of velocity are as follows:—

First, with Silkstone coal dust and with obstructions in the form of "props and bars" in the gallery (pp. 155–6), it is stated that the velocity, between one contact-breaker 175 feet from the point of ignition and a second contact-breaker at manometer A (200 feet distant from the first) was 2014 feet per second in No. 62 experiment, and that between the point of ignition and a point 275 feet distant it was 475 feet per second in No. 53 experiment.

Secondly, with the same coal dust and without obstructions, the velocities between six points—the first at the igniter, the second 59 feet, the third 109 feet from the first, and so on, with an increase of 50 feet successively up to the sixth—were 39·7, 252·5, 72·5, 119·0, and 222·6 feet per second respectively.

Thirdly, with South African coal dust, and presumably with props and bars in the gallery, the velocities between five points—the first 12 feet distant from the igniter, the second 59 feet, the third 109 feet from the first, and so on, with an increase of 50 feet, as in the last case, up to the fifth—were as given below in feet per second:—

FIG. 3.—Flame issuing from the Downcast.

Number of experiment	1–2	2–3		3–4	4–5		Page
102	113·5	85·0	...	118·0	554·5	...	191
104	138·5	320·5	...	160·0	450·5	...	196
105	632·0	52·9	...	125·0	143·5	...	200

Considered as a whole, these results are so discordant that it is impossible to draw any other conclusion from them than that either the instruments are at fault or that there is some disturbing element at work, due, most probably to variableness in the quantity of dust suspended in the air in different sections of the gallery when the flame of an explosion is traversing it.

Owing to the very nature of the experiment, it is obviously impossible to provide that each section shall always contain the same quantity of dust, mixed with the same degree of uniformity in the air which occupies it, at the instant an explosion is passing through it. It is equally obvious that, unless that condition can always be rigidly complied with, the results cannot be concordant as between one section and another, although the sum of the results may seem to be fairly uniform when one explosion is compared with another. But the same absence of uniformity must necessarily obtain in the workings of a mine when an explosion is passing through it, and, therefore, if the aim of the committee is to reproduce that phenomenon as nearly as possible in their artificial gallery, the observed discordances show that they have already succeeded in doing so.

The haulage roads, along which the coal is conveyed from the working places to the shaft, contain larger quantities of very fine coal dust than any other parts of a mine, and ever since the time when the coal-dust theory of great explosions was first propounded,[1] they have been recognised as the routes along which explosions, commenced at any point in a mine, travel to every other part of the workings, however remote. This was well exemplified in the plan which accompanied the description of Penygraig Colliery explosion[2] (1880), previously referred to. It has also been recognised, of course, that if coal dust could be prevented from accumulating in the roadways, or be rendered innocuous by water or other means, the range and disastrous effects of explosions would be greatly limited. To prevent accumulation in the first place by the employment of mine-waggons with dust-tight bodies, *filled only to the brim and provided with covers*, is obviously the best possible expedient that could be adopted, and would be infinitely preferable to the present careless system of carrying the coal in all sorts of leaky or over-loaded waggons, from which it dribbles or falls upon the roads, and is then ground or trodden into the very dust which constitutes the danger.

Under existing conditions, as regards the mode of construction of mine-waggons, the production of coal dust is inevitable; and although there is no legislative enactment in this country compelling the mine-owners to do so, many of them already water the dust in their haulage roads once or twice a day in order to render it innocuous. But in many other mines water cannot be used for this purpose, as it causes the ground above or below the seam to swell or fall to pieces, and consequently the dust is allowed to remain dry. It has been proposed to give the owners of the latter class of mines the alternative of rendering the dust innocuous by covering it from time to time with inert dust, or with a hygroscopic or other salt. The committee have, accordingly, directed their attention to the question of using inert dust for this purpose, and made careful experiments, which are described in chapters vi. and vii., to ascertain, first, the effect that dust of this nature has in arresting the progress of an explosion, and, secondly, the cost of applying it practically in Altofts Colliery.

The inert dust for both purposes has been prepared by grinding the roof-stone of one of the seams of Altofts Colliery in a roller-mill at a cost of 2*s*. per ton.

In the five following experiments a standard length of 275 feet of the gallery was strewn with coal dust, the igniter was fired at the inner end of this zone, and the space at its outer end, 150 feet in length, was treated as follows:—

Number of experiment	Left dustless or strewn with stone dust or coal dust: Dustless ft.	Stone dust ft.	Coal dust ft.	Pressures recorded by the manometers: B lb.	A lb.
55	150	—	—	40	100
57	—	150	—	40	9
58	—	100	50	31	17·5
62	100	—	50	39·5	84
116	—	100	50	33·7	9·18

In experiment 55 the flame passed just beyond the outer end of the dustless zone; in 57 it penetrated 55 feet into the stone-dust zone; in 58 it penetrated 54 feet into the stone-dust zone; in 62 it passed through the dustless and coal-dust zones, and shot out 100 feet beyond the latter; in 116 it penetrated 22 feet into the stone-dust zone.

These experiments show that a zone of stone dust is more efficient in arresting an explosion than a dustless zone, and thus help to answer, but do not completely solve, one of the questions still being considered by the Royal Commission on Mines, as to whether it is desirable to compel the owners of mines in which water cannot be employed for the purpose of laying the dust to surround certain lengths of the main roadways with brickwork or concrete, and keep these lengths continually wet.

In chapter vii. it is shown that it costs 1·85*d*. per yard in Altofts Colliery and 2*d*. per yard in New Moss Colliery, which is under the same management, to "dress" the roadways with stone dust. The experience obtained in Altofts Colliery, which is practically free from coal dust, in consequence of the fact that many of the mine-waggons are dust-tight, the remainder nearly so, that none are filled above the level of the brim, and that the traffic is very slow, is inapplicable to the case of most other mines in which all, or nearly all, these conditions are exactly the reverse, so that no conclusion as to the probable cost in the latter can be drawn from it. At best it seems rather a roundabout way of solving the question: first, to allow coal dust to accumulate; secondly, to cover it or mix it with inert dust; and, finally, to have to remove the mixture when the accumulation becomes so great as to commence to impede the traffic.

The "Microscopical Investigations" described in chapter ix. refer to the microscopical examination of grains and aggregations of coked coal dust, grains of other matter, and fragments of fibrous substances that have been subjected to a high temperature, and are accompanied by twenty full-page beautifully coloured illustrations, which remind one more of a birds'-egg book than of a serious treatise relating to a subject connected with mining. It is not easy to see how these investigations are likely to affect the question one way or another, but possibly the committee may be able to extract some information from them that does not appear on the surface.

Chapter i. of part ii., written by Dr. Wheeler, the accomplished chemist and physicist attached to the testing station, entitled "The Mode of Propagation of Coal-dust Explosions: Introduction," purports to "record the main facts that have been established regarding the mode of propagation of coal-dust explosions," but does not deal with anything specially new or original.

The second chapter of part ii., and the appendix on "Experiments with Welsh, Scotch, and South African Coals," have been already referred to so far as seems to be necessary in the present place.

The volume concludes with lists of the illustrations and plates, and an index to the subjects, and is, as a whole, most creditable to the publishers. W. GALLOWAY.

[1] Proc. Roy. Soc., vol. xxiv., p. 354 (1876).
[2] *Loc. cit.*

EXPLORATIONS IN NEW GUINEA.

AT the meeting of the Royal Geographical Society on January 30, Dr. H. A. Lorentz gave an account of his latest journey in New Guinea, in the course of which he succeeded in reaching the snow-covered peaks of the main range. Much interest attaches to those regions in the tropics where perpetual snow occurs, with their transitions from the luxuriant vegetation of the equatorial zone to the scanty flora of the snow-line, which on the slopes of Wilhelmina Peak was reached at an altitude of

about 4460 metres, and above this the mountain rose to 4750 metres. A former extension of glaciation in this part of the range down to the altitude of about 4000 metres was shown by striæ on the rock surfaces and the presence of a small, typical glacier lake, though no glaciers are existing in this part of the range now. The expedition encountered many difficulties in the journey from the coast to the mountain ranges in the interior, but, taught by the experiences of the first expedition, special arrangements were made to push up the North river so far and so rapidly as possible to avoid the delays and sickness incidental to a prolonged stay in the low and marshy region.

Besides the geographical information obtained, much work was also done in zoology and botany. A thousand birds' skins and ten thousand insects collected during the expedition are now being studied at Leyden, and numerous new species have been obtained; the Australian character of the fauna is well marked, and especially so among the fishes captured in the North river.

The botanical collection, ranging from the tropical to the Alpine flora, shows a majority of plants having a Malayan character, but there are so large a number of endemic forms that New Guinea and the adjacent islands seem to be separable as a botanical region from the Soenda Islands. Savannas, consisting largely of intruding species from North Australia, occur; but the Alpine flora, on the other hand, is said to be of a northern character, resembling that of the mountains of Java, Sumatra, and the Himalayas.

The Wilhelmina Peak is stated to consist of Alveolina limestone, and generally the geological age of the formations traversed was of comparatively recent date; eruptive rocks were only met with near Geelvink Bay. A very interesting collection of ethnological objects was obtained, and many observations were made concerning the Papuans living in the plains and those of the mountains.

The results of this expedition, together with those of the British expedition now in New Guinea, should greatly extend our knowledge of this region.

RADIO-ACTIVITY AS A KINETIC THEORY OF A FOURTH STATE OF MATTER.[1]

THERE are many points of resemblance between the movements of the molecules of a gas and the movements of those corpuscular radiations with which we have become acquainted in following up the discovery of radio-activity. In both cases we find that things of extremely minute dimensions are darting to and fro with great velocity, and in both cases the path of any one individual is made up of straight portions of various lengths, along which it is moving uniformly and free from external influence, and of encounters of short duration with other individuals, when energy is exchanged and directions of motion are altered. There is even a resemblance in the universality of each movement. The motion of molecules is a fundamental fact throughout the whole of our atmosphere, and, indeed, in all material bodies; the motion of the radiant particles emitted by radio-active substances is also widely distributed, and of great importance. Taking Eve's estimate of the usual ionisation of the air, we can calculate that in this room, in every second, some thousands of α and β particles enter into existence, complete their paths through all the atoms they meet, and sink into obscurity; some of them, viz. the α particles, as atoms of helium. These last move through definite and well-known distances in the air. For example, a third of those which are due to radium products move through a range of just above 4 cm., an equal number have a range of just below 5 cm., and again an equal number move through 7 cm., and the speed is so great that the life of each α particle as such is completed in about a thousandth-millionth of a second. They leave their mark behind them in the ionisation of the air through which they have passed, and in the heat into which their energy has been commuted. The former effect is easily detected by the sensitive measuring instruments which we now possess; the latter is too small to measure, and must be greatly increased by the aid of radium itself before it can be investigated. But on a large scale, which takes into account the distribution of radio-active material through the earth, the sea, and the air, the effects are of first-rate importance to the physical conditions of our earth.

If we compare the movements a little more closely, we find differences as interesting as the resemblances. The motions which the kinetic theory of gases considers are those of the molecules of which gases consist; in the case of radio-activity, the things which move are quite different. They are sometimes electrons, which have come to be called β rays when their speed is great, and kathode rays when it is somewhat less; or they are γ or X-rays, which are new things to us; or if as α particles they are helium atoms, such as we have known before, they move with excessive speeds which give them quite new properties. In general, the radiant particles move hundreds of thousands of times as fast as the gas molecules do, and it is, no doubt, on account of this fact, as well as through their usually extreme minuteness, that their power of penetrating matter is so great. When two molecules of a gas collide, they approach within a fairly definite distance, which we call the sum of the radii of the molecules, and the approach is followed by a recession and new conditions of motion. Each molecule has, as it were, a domain into which no other molecule can penetrate. But the defences which guard the domain are of no account to the vigorous movements which we are considering now. The radiant particles pass freely through the atoms, and their encounters are rather with one or other of a number of circumscribed and powerful centres of force which exist within the atomic domain, and act with great power when, and only when, approached within distances which are small in comparison with the atomic radius. It is on this account that the new theory opens out to us such possibilities of discovering the arrangement of the interior of the atom. Never before have we been able to pass anything *through* an atom; our spies have always been turned back from the frontier. Now we can at pleasure cause to pass through any atom an α particle, which is an atom of helium, or a β particle, which is an electron, or a γ or X-ray, and see what has happened to the particle when it emerges again, and from the treatment which it seems to have received we must try to find out what it met with inside.

The newer movement exists superimposed upon the other. Its velocities are so great that the gas (or liquid or solid) molecules are, in comparison, perfectly still. There is, as it were, a kinetic theory within a kinetic theory; there is a grosser movement of gas molecules which has long been studied, and in the same place and at the same time there is a far subtler and far more lively movement which is practically independent of the other. Your vice-president, Sir William Crookes, was the first to find any trace of it. The behaviour of the kathode rays in the vacuum tubes which he had made showed him that he was dealing with things in no ordinary condition. Whatever was in motion was neither gas, nor solid, nor liquid, as ordinarily known, and he supposed it must be possible for matter to exist in a fourth state. We have gone far since Sir William's first experiments. The X-ray tube and radium have widely increased our knowledge of phenomena parallel to those of the Crookes tube. But I think we may still be glad to use Sir William's definition.

There is another very striking characteristic of the newer kinetic theory which differentiates it sharply from the older. The experiences of any one of the radiant particles in an atom which it crosses are quite unaffected by any chemical combination of that atom with others; that is to say, by any molecular associations it may have. Naturally, this simplifies investigation. We may, no doubt, ascribe this state of things to the fact that a radiant particle is concerned rather with the interior of the atom than with the exterior, and that it is the latter which is of importance in chemical action.

Let us take notice of one more important difference. The molecules of a gas move with velocities which vary at every collision, yet vary about a certain mean. But the peculiar motion of the radiant particle is only tem-

[1] Discourse delivered at the Royal Institution on Friday, January 27, by Prof. William H. Bragg, F.R.S.

porary. For only a very short time can any ray be described as matter in a fourth state; at the end of it the extraordinary condition has terminated, the particle has lost its tremendous speed or suffered some other change, and the ray ceases to exist. Speaking technically, we are dealing with initial, not permanent, conditions.

Let us now come back to resemblances between the two kinds of motion, for there is one point of similarity which is not quite so obvious as others I have mentioned, and is, I think, of the greatest importance; in fact, it is largely on account of this similarity that I have ventured to put the two theories together for comparison.

When the first experimenters in radio-activity allowed their streams of rays to fall upon materials of various kinds, they found that the irradiated surfaces were the sources of fresh streams of radiation. The secondary rays were sometimes of the same nature and quality as the primary, sometimes not. Further, they found that the secondaries, on striking material substances, could produce tertiaries, and so on. The examination of all the variations of this problem—the investigation of the consequences of changing the primary, of changing the substance, and last, but not least, of changing the form of the experimental arrangements—has been the cause of an enormous amount of work. There is a large literature dealing with secondary radiations of all kinds which, I imagine, but few have read with any completeness, and the subject has become, on the surface at least, complicated and difficult. Now I believe that it is possible to clear away the greater portion of this complexity at a stroke by the adoption of an idea which makes it possible to describe and discuss the whole of these phenomena in a very simple way. When an encounter takes place between two gas molecules, we suppose that the sum of the energies of the two is the same after the collision as before, and, further, that there are just two things to consider—two molecules—after as well as before. I think that we may carry this idea over almost bodily to the newer theory. A radiant particle encounters an atom. The particle is a definite thing; it contains a definite amount of energy, and whether it is an α, or β, or γ, or X-ray, its energy is to be found almost entirely inside a very minute volume. The encounter takes place. When it is over there are still two things, an atom and a radiant particle, going away from it. The sum of the energies of the two is still the same, which means that we deny a possibility much considered at one time, viz. that in the encounter the atom could be made radio-active, and could unlock a store of energy usually unavailable. We suppose there is no energy to be considered except the original energy of the radiant particle, and we suppose that there are not now two or more radiant particles in place of the original one, which also is a limitation on previous ideas. It is a theory which ascribes a corpuscular form to all the radiations. Each particle, α, β, γ, or X, is to be followed from its origin to its disappearance, and we have nothing to think of but the one particle threading its way through the atoms. It loses energy as it goes, though little at any one collision, and it passes out of our reckoning when it has lost it all. There are no secondary radiations other than radiant particles moving in directions which are different from those in which they moved at first. Even when a kathode ray excites an X-ray in the ordinary Röntgen tube, or the X-ray excites a kathode ray in a manner almost as well known, it is hardly an exception to this rule. The kathode ray has an encounter with an atom and disappears; simultaneously the X-ray comes out of the atom, a circumscribed corpuscle carrying on the energy of the kathode ray. There is a change, but it extends only to the external characteristics of the carrier of energy. The X-ray passes through the glass wall of the X-ray bulb, or at least it does so sometimes; it may pass through other matter as well, but sooner or later it has a fatal encounter with an atom, and the reverse change takes place. In all cases, in that of the undeviating α ray, or the β ray which suffers so many deflections, or the γ or X-rays, it is a matter of tracing the movements of individual minute quantities of energy until they finally melt away.

Let us consider one or two simple experimental results from this point of view in order that we may illustrate this corpuscular theory, and at the same time may learn something of the properties of the corpuscles and of the arrangements of the atoms through which they pass.

We take first one of the simpler cases, the movement of an α particle through a gas. The relatively large mass of the particle gives it an effectiveness which the other radiations do not possess. It moves straight through every atom it meets, and ionises most of them. Very rarely does it suffer any deflection from its course until its velocity is nearly run down. Then, indeed, it does appear to depart considerably from the straight path, and it may be that it is much knocked about by collisions before it finally comes to comparative rest. In this way we may explain the distribution of the ionisation along its path, which increases slowly at first and rapidly afterwards, until the α particle has nearly finished its journey; it then falls off rapidly. Considering that the ionisation increases as the particle slows down and spends more time in each atom, and considering the more broken nature of the path near its end, the reason of these peculiarities is clear enough. Apart from its comparative simplicity, there are some other very interesting features of the particle's motion. It is found, for example, that the loss of energy which the particle incurs in crossing an atom is proportional to the square root of the atomic weight very nearly, and there is no certain explanation as yet of this curious law. And again, Geiger has examined the small scattering that does occur, and found that α particles when moving quickly may be swung round completely even by the thinnest films of gold leaf, though the number is so small that the effect would have remained undetected had it not been for the scintillation method which he and Rutherford have perfected. He has found that about one particle in 8000 is returned in this way from a gold plate, which need consist only of a few thicknesses of gold leaf in order to give the maximum effect.

Now let us take an example from the behaviour of the β rays. The β particle is so light that it is easily deflected, even though it moves several times as fast as the heavier α particle. Because it therefore possesses little energy its effects are much smaller, and no one has yet succeeded in handling a single β particle in the same way as Rutherford and Geiger have handled the other. We are obliged to content ourselves with observations of the effects of a crowd of β particles, since the combined action of many is necessary to give us an observable result; and at the same time that the β particle gives much less effect than the α, it has a much more irregular course, so that the problem is doubly difficult. We are, in fact, only just beginning to understand it. There is a compensation in the fact that its very liability to deflection makes it all the more interesting an object. It is possible—and this is the particular β-ray problem I wish to consider now—to examine the deflection of a single β particle by a single atom; the parallel result in the kinetic theory of gases has never, of course, been achieved.

Suppose that we project a stream of β rays against a thin plate and measure the relative number sent back, which we do by measuring the ionisations caused by the incident and returned rays respectively. We do this for varying thicknesses of the plate, and plot the results, as, for example, Madsen has done. His plate was made of gold leaves, which could be had of extreme fineness. From the relation thus obtained, it is possible to obtain with confidence the amount of β radiation that would be returned by the thinnest plate that could be imagined, only one molecule thick. In such case the particles turned back could have had but one collision, and we have achieved our purpose. Madsen's figures show that a plate weighing 4 milligrams to the square centimetre turned back a tenth of the β particles that fell upon it, and, so far as can be judged, the ratio of the proportion turned back to the weight of the plate would be almost doubled for very thin plates. We could go more into detail, and find the distribution of those that are returned; we should then have data from which we might determine in some measure the distribution of the centres of force inside the atom. We cannot follow this up now, but I would like to direct your attention to a curious indication which we obtain when we compare the results for gold with those which Madsen found for aluminium. They show that the lighter metal turns back fewer β particles, and that its power of absorbing a stream of rays is rather an absolute

abstraction of energy. There is clearly an actual absorption effect, which is to be distinguished from the scattering effect. Indeed, the two effects are obviously of different importance in the two cases. When a β ray strikes a gold atom it must be much more liable to deflection than when it strikes the lighter atom of aluminium. On the other hand, I think it can be shown clearly that in ploughing through aluminium atoms there is a relatively quicker absorption of energy. We may illustrate this by a rough model. Let us stand an electromagnet upright on the table, and let us suspend another magnet so that it can swing over the fixed one and just clear it. If we draw back the swinging magnet and let it go towards the fixed one, the currents running so that the two repel, then as the moving magnet tries to go by there will be a deflection depending on the relative speed, the closeness of approach, and the strength of the poles. This may represent the turning aside of an electron by a centre of force inside an atom. Now let the magnet at the table be supported by a spiral spring so as to be still upright, but have some freedom of motion; then, when the experiment is repeated, the swinging magnet pushes the other more or less to one side; it is less deflected, but it has to give up some of its energy. This is exactly what happens in the case of the β particle. The centre of force in the gold atom behaves like the stiffer electromagnet on the table; it deflects the electron more, but robs it of less energy in doing so. It will not do to suppose the gold atom to differ from the aluminium atom simply in the number of centres of force, such as electrons, which it contains if it is supposed that they all act independently. There is some other fundamental difference, equivalent to a difference in the stiffness with which the electrons are set in their places. There are two things to be expressed in the behaviour of the atom towards the β particle, as has been pointed out several times. H. W. Schmidt has actually calculated them from experiments which gave them indirectly and somewhat approximately. The method I have just outlined gives one of them directly, viz. that which is called the scattering coefficient, and I think the other can also be found directly by a method which will serve as an illustration of the behaviour of γ rays.

We must first, however, consider the part which γ and X-rays play generally in this theory. Workers are by no means agreed as to the proper way in which to regard them, but there is no need to enter at once on a discussion as to their nature. It is well known that they have the most extraordinary powers of penetration, and are unaffected by electric or magnetic fields. They have one property which alone, as I think, brings them within our experience; that is to say, the power of exciting β rays from the atoms over which they pass. Were it not for this they would still be unknown. When we examine this production of β rays, we find that in the first place their speed depends on the quality of the γ rays which cause them, and not on the nature of the atoms in which they arise; in the second, that the β rays to a large degree continue the line of motion of the γ rays, as if the latter pushed them out of the atoms; and, lastly, that the number of the β rays depends on the intensity of the γ rays. It is these facts which suggest the simple theory I have already described. The γ ray is some minute thing which moves along in a straight line without change of form or nature, which penetrates atoms with far greater ease than the α or β particle, which is not electrified, and which sooner or later disappears inside an atom, handing on a large share of its energy to a β particle which takes its place. The absorption of γ rays is simply the measure of their disappearance in giving rise to β rays, one γ ray producing one β ray, and no more.

We find the same sort of scattering in the case of γ rays as in that of β rays. Of a stream of rays directed against a plate which it can penetrate easily, we find that a few are turned completely back, a very much larger number are only slightly turned out of their path, and the rest go on. The scattered rays are very similar to the original rays; there is no need to suppose that the original ray disappears, to be replaced by a secondary, any more than there is to suppose that α and β rays disappear and are replaced by others in similar cases. When, therefore, a γ ray enters an atom, three possibilities await it. The first is a negative one; it may go through the atom untouched, and this must happen in the majority of cases; the second chance is that of deflection, and the third that of conversion into a β ray, using the word conversion in a general sense, without going into details as to the nature of the process.

Now we may consider our γ-ray problem. Suppose a stream of these rays passing over a block of any substance, such as aluminium, or zinc, or lead. When they are really penetrating rays they are equally absorbed by equal weights of these materials, which means that in equal weights equal numbers of β rays spring into existence. If these β rays were able to move through equal weights of the metals, we should find in each metal the same "density" of β rays; and the important point is that this is independent of whether the rays are straight or crooked in their paths. If ten lines of given length were begun in every square centimetre of a sheet of paper, the ink used in drawing them would be independent of the straightness of the lines, but proportional to their length. Now if we make a cavity in each metal the β rays will cross it in their movements to and fro, and if a little air is introduced into the cavity, the ionisation produced in it will be a measure of the density of the β rays, and therefore the average distance each moves in the metal. Experiment shows that we get twice as much ionisation in a cavity in the lead as in a similar cavity in the aluminium, and we conclude that the β particle really has a longer track in the heavier metal. This experiment gives us the second constant of β-ray absorption, that is to say, the rate at which its energy is taken away from it; the other experiment gave the chance of deflection only. We see that the path of a β ray in aluminium is more direct, but of less length, than in lead; in the latter metal it has really a longer path, but it does not get so far away from its starting point because it suffers so many more deflections.

Finally, let us take a problem from the X-rays. Let us see how we may test the idea that X and γ rays do not ionise themselves, but leave all the work to be done by the β rays which they produce. Suppose a pencil of X-rays to pass across a vessel and to produce ionisation therein. It is convenient to use, not the original X-rays, which are heterogeneous, but the rays which are scattered by a plate of tin on which the primary rays fall. Such "tin rays," as we often call them briefly, are fairly homogeneous, and give kathode rays of convenient penetration. In some experiments of mine the rays crossed a layer of oxygen 3·45 cm. wide, having a density 0·00137, and the ionisation produced was 227 on an arbitrary scale. The result may be put in the following way. Suppose, provisionally, that all this ionisation is done indirectly; the oxygen has converted so much X-ray energy into kathode-ray energy, and these kathode rays penetrating their one or two millimetres of oxygen, which is all they can do, have ionised the gas. Then we may say that, in crossing a layer of oxygen weighing $3·45 \times 0·00137$, or 0·00473 gr. per sq. cm., enough kathode rays have been produced to cause an ionisation of 227 units, and therefore that a layer weighing one milligram per sq. cm. would produce 48 units in the same way. We now proceed to compare this production in oxygen with the similar effect in a metal such as silver. Stretching a silver foil across the chamber in the path of the rays, we find that under the same intensity of rays the ionisation is largely increased, and the change is due to kathode rays which the X-rays have generated in the silver. Not all these rays get out of the silver, but we can overcome this difficulty by taking silver foils of different thickness, drawing a curve connecting the effect of the foils with their thicknesses, taking the curve back to the origin, and so finding what would be the effect of a foil so thin that all the kathode rays did get out. In my case I found that a milligram of silver produced enough kathode rays to give an ionisation 1580. This is thirty-three times as much as the oxygen could do. Now, according to our theory, this should be because silver absorbs tin rays thirty-three times more than oxygen does, and experiment showed this to be very nearly the case. In finding the absorbing power of oxygen, I measured first those of carbon and oxalic acid, and then proceeded by calculation, for the absorption in a gas is difficult to determine.

Two interesting points appeared in this experiment. In the first place, the ratio between the two quantities of kathode rays, which appear on the two sides of a silver leaf through which the "tin rays" pass, is nearly constant, for different thicknesses of leaf. With the thinnest leaf obtainable each quantity was about half its full value. It would have been desirable to have had still thinner leaves; but it is fairly clear that the ratio would be nearly the same for extreme thinness. The kathode radiation, which appears on the side of the leaf whence the X-rays emerge, is 1·30 times that which appears on the other, and we may take it that this would be the case even if the leaf were but one atom thick. Thus when an X-ray plunges into an atom in which its energy is converted into that of a kathode ray, the kathode ray may emerge at any point, but there is a 30 per cent. greater chance that it will more or less continue the line of motion of the X-ray than that it will not. In previous work on the conversion of γ-ray into β-ray energy, I have found that the β ray may practically be supposed to continue the line of motion of the γ ray, so that there is a great difference in behaviour of the two classes of ray in this respect. It is remarkable that the scattering of the γ rays shows also a much greater dissymmetry than is found in the case of the X-rays. It looks as if the β rays that appear when γ or X-rays impinge on atoms are related rather to the scattered than to the unscattered primary rays. Putting it somewhat crudely, no doubt, it might be said that when a γ or X-ray is deflected in passing through an atom, it runs a risk of being converted into a β ray in the process, so that β rays are found distributed about the atom in rough proportions to the secondary γ or X-rays. In the case of γ rays this practically amounts to their all going straight on at first; in the case of X-rays the distribution is more uniform.

Another interesting point arises in this way. When the X-rays from tin are allowed to pass into the ionisation chamber through increasing thicknesses of silver foil, the kathode rays grow at a rate which is not represented by the exponential curve usually assumed. The amount is for some time more nearly proportional to the thickness of the foil. A second foil adds its own effect without destroying much of the one on which it is laid. This may easily be ascribed to the relation of the ionisation due to the β particle to the energy it has to spend. The ionisation is nearly all at the end of the path, and the second layer does not absorb the rays made in the first because they are still at the beginning of their career.

These few experiments which I have described may serve to illustrate both the justice and the convenience of placing all these rays, α, β, γ, and X, in one class. We are tempted to consider them all as corpuscular radiations of some sort, and we then look upon our researches into their behaviour as attempts to understand the collisions of the various new corpuscles with the constituent centres of force in the atoms. But if we ascribe corpuscular properties to the γ and X-rays, we are led far away from the original speculations as to their nature. Stokes supposed them to be spreading æther pulses, but in his theory the energy of the pulse spreads on ever-widening surfaces as the time passes, and is utterly insufficient to provide the energy of the β rays which the γ or X-rays excite. Some sort of mechanism has to be devised by which the energy of the γ ray moves on without spreading, so that at the fateful moment it may be all handed over to the β ray, which carries it on. I had the hardihood myself to propose a theory of this kind. My idea was that the γ or X-ray might be considered as an electron which had assumed a cloak of darkness in the form of sufficient positive electricity to neutralise its charge. Nor do I see any reason for abandoning this idea, for it is at least a good working hypothesis. It means, of course, that not only does the energy of the β ray come from the γ ray, but the β-ray itself.

Many insist that my neutral corpuscle is too material, and, that something more ethereal is wanted, for it appears that ultra-violet light possesses many of the properties of X and γ rays. It can excite electrons to motion, and sometimes the speed of the electron depends on the quality of the light, and not on the nature of the material from which it springs. They propose, therefore, a quasi-corpuscular theory of light, γ and X-rays being included. The immediate objection to this proposal is that it seems to throw away at once all the marvellous explanations of interference and diffraction which Young and Fresnel founded on a theory of spreading waves, and I do not think anyone has yet made good this defect. The light corpuscle which is proposed is a perfectly new postulate. It is to move with the velocity of light, keeping a circumscribed and invariable form, to have energy and momentum, and to be capable of replacing and being replaced by an electron which possesses the same energy but moves at a slower rate, and, of course, it has to do all that the old light-waves did. The whole situation is most remarkable and puzzling. We are working and waiting for some solution which, perhaps, will come in a moment unexpectedly. Meanwhile, we must just try to verify and extend our facts, and be content to piece together parts of the puzzle, since we cannot, as yet, manage the whole. My object to-night has been to show you how we may conveniently bind together a large number of the phenomena of radio-activity into an easily grasped bundle, using a kinetic theory which has many points of resemblance to the older kinetic theory of gases.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—It is proposed to confer the degree of Master of Arts, *honoris causa*, upon Mr. K. J. J. Mackenzie, university lecturer in agriculture.

On Thursday next, February 16, a Grace will be offered to the Senate recommending that a site on the Downing Ground be assigned for a building for the department of physiology, to the east of the School of Agriculture. At the same Congregation a further Grace will also be brought forward recommending that a space to the south of, and adjoining, the proposed building for the department of physiology, be assigned as a site for a laboratory of experimental psychology.

OXFORD.—On February 4 Prof. T. W. Edgeworth David, C.M.G., F.R.S., delivered a public lecture before the University, in which he described the part he had taken in Sir Ernest Shackleton's Antarctic Expedition of 1907–9, including the ascent of Mount Erebus and the reaching of the South Magnetic Pole. On February 7 the honorary degree of D.Sc. was conferred on Prof. David.

The report of the committee for anthropology for the year 1910, just presented to Convocation, contains a record of continuous and healthy development of the study in Oxford. The salary of the curator of the Pitt-Rivers Museum has been raised from 200*l.* to 500*l.* per annum, and a readership has been founded in social anthropology, to which the secretary to the committee, Mr. R. R. Marett, Fellow of Exeter College, has been appointed. A large number of lectures have been delivered in the course of the year under the general heads of physical anthropology, psychology, geographical distribution, prehistoric archæology, technology, social anthropology, and philology, besides special lectures for Sudan probationers, and addresses on the art of prehistoric man in France, by M. Emile Cartailhac.

The consideration of the proposed amendments to the statute on faculties and boards of faculties has been resumed by Congregation.

IT is announced in the *Revue scientifique* that Prof. Hans Meyer has presented 150,000 marks to the University of Leipzig for the inauguration of an institute of experimental psychology.

WE have received from the honorary secretary of the Association of Teachers in Technical Institutions a copy of a letter sent by the association to the principal of the University of London directing attention "to the marked inequality of the requirements of the examiners for a 'pass' in the respective subjects" for the intermediate and final B.Sc. external examinations. Tabulated statistics, drawn up by the association from the University Calendar, show that in 1909 the following percentages of candidates, entering for the various subjects of science in the intermediate external examination, failed:—chemistry, 46·9; physics, 30·7; pure mathematics, 25·3; applied

mathematics, 14·4; botany, 47·8; zoology, 28·8; and geology, 14·3. The corresponding numbers in the B.Sc. examination of 1909 were:—chemistry, 58·5; physics, 30·5; pure mathematics, 35·4; applied mathematics, 42·1; botany, 33·3; zoology, 14·3; and geology, 14·3. The principal is asked to bring these and other points for consideration before the Senate and Council for External Students, since, in the opinion of the association, a serious injustice is being done to students and teachers.

We learn from *Science* that the bequests from the Kennedy estate for educational and public purposes are even larger than had been anticipated. Columbia University receives 472,000*l.*, New York University 190,400*l.*, and Robert College, Constantinople, 360,000*l.*; the bequests to the New York Public Library and the Metropolitan Museum of Art are about 560,000*l.* Barnard College and Teachers College, Columbia University, each receive 20,000*l.*, as do Hamilton College, Elmira College, Amherst College, Williams College, Bowdoin College, Yale University, Tuskegee Institute, and the Hampton Institute. Lafayette College, Oberlin College, Wellesley College, Berea College, and Anatolia (Turkey) each receive 10,000*l.* *Science* also states that Mr. Carnegie's latest gift of 760,000*l.* to the Technical Institute in Pittsburgh is to be used approximately as follows:—460,000*l.* for increase of present endowment, 275,000*l.* for new buildings, 20,000*l.* for additional equipment, and 5000*l.* on grounds. The residue of the estate of the late Dr. Seesel, valued formally at "not more than 50,000 dollars," is divided between Yale and the University of Leipzig. With the income there is to be founded at each institution the "Theresa Seesel Fund" in memory of his mother, to be used for researches in biology.

The first volume of the report for the year ended June 30, 1910, of the U.S. Commissioner of Education has been received from the Bureau of Education at Washington. As usual, the publication of purely statistical information is postponed for the later volume. The commissioner, Dr. Elmer Brown, in his introduction to the volume ably summarises the tendencies and advances in the various grades of education which may be regarded as the outstanding features of the educational work of the year under review. The part of the introduction dealing with higher education is of special importance. Dr. Brown points out that by its higher education the place of the United States in the world's civilisation and its prestige before the more enlightened nations are largely determined. "It is," he says, addressing his countrymen, "a patriotic duty of the highest order that our colleges and universities, in all of the States, should get away from the more injurious forms of competition and enter into more effective cooperation." He enumerates many weaknesses requiring correction. He urges that an agreement among the colleges with respect to admission requirements, which should do away with minor differences that harass the preparatory schools, would rid the educational situation of some of its most serious embarrassments. There is, he continues, a great deal of possible division of labour, particularly as regards instruction and research, which is not yet realised. Much has yet to be done in the way of a general survey of the present provision in American institutions of higher education for advanced instruction with the view of determining where enlargement is needed. The excessive variations in the worth of American academic and professional degrees is still, says Dr. Brown, a cause of reproach abroad, and involves much injustice among Americans at home.

A national conference will be opened at the Guildhall on February 28, at 3.30 p.m., by the Lord Mayor, with the object of securing a national system of industrial training. The conference has been organised by a special committee of the elected representatives of the chief associations of employers and workers and educational authorities. The intention is to urge upon the Government to supplement our present system of elementary education by providing by legislation a complete system of industrial, professional, and commercial training. Several resolutions will be submitted at the conference, among which may be mentioned the following:—"That this conference views with grave concern the large number of children annually leaving school without practical training for definite vocations, and resolves that a national system of industrial, professional, and commercial training should be established, to which the children shall pass as a matter of course (unless the parents are prepared to undertake their future training) and without interval, for a definite period, to be thoroughly trained for entry to the particular calling for which they are best fitted, such training to be under fully qualified instructors. That the Government be urged to provide by legislation such a complete system of training, free to all scholars, and the expenses thereof defrayed from the National Exchequer." The National Industrial Education League, which it is proposed to establish at the meeting, will be composed of 2500 organised bodies of workpeople engaged in trade union, cooperative, and educational work, and, so far as can be at present ascertained, they represent more than three millions of workers, comprising 365 trades and professions in 421 cities and towns. Intending supporters of the league can obtain further information on application to the honorary secretaries, Craig's Court House, Charing Cross, London, S.W.

At the meeting of the Royal Society of Arts on February 1, presided over by Lord Cromer, Mr. P. J. Hartog read a paper on examinations in their bearing on national efficiency. He raised the important question as to whether it was not possible to test "general ability," and to separate the ablest candidates by methods involving less strain both on the successful and the unsuccessful candidates? Would it be possible, without reintroducing the evils of jobbery, to follow the lines laid down by Lord Cromer in the Egyptian Civil Service, and by Lord Selborne in choosing candidates for the Navy? He suggested the appointment of a Royal Commission to deal with the whole question, with a suitable reference, such as "To investigate and report upon the methods and efficiency for their purpose of examinations carried on by Government departments and other public bodies in the United Kingdom; to inquire into the influences of examinations on the previous education of candidates; and to suggest such changes as may seem desirable." The commission, he said, should be a small one, presided over by a statesman with experience of affairs, and there should be no attempt to achieve the impossible by including in it representatives of all parties concerned. Lord Cromer opened the discussion which followed. He compared the merits of competition and selection for securing the best candidates for any office. The principle of selection, he maintained, if only it can be properly carried out, possesses merits superior to those of competition. The former may or ought to result in the creation of leaders of men. The latter tends rather to produce a dull level of mediocrity. Of late years there has been a tendency, notably in the military, naval, and diplomatic services, to adopt the principle of selection in dealing with all the later stages of the careers of public servants more thoroughly than formerly. This movement, far from being arrested, should be pushed still further. The case of first appointments presents, naturally, greater difficulties. Some few years ago it became necessary to create a Sudanese Civil Service. In the first instance, the appointments were practically made by Lord Cromer. He found it, he said, a difficult task, but whatever success has attended the administration of Egypt during the last thirty years has been mainly due to the care which was taken in selecting and promoting officials.

SOCIETIES AND ACADEMIES.

London.

Royal Society, February 2.—Sir Archibald Geikie, K.C.B., president, in the chair.—Colonel Sir D. **Bruce**, F.R.S., Captains A. E. **Hamerton** and H. R. **Bateman**, and Dr. R. Van **Someren**: Experiments to investigate the infectivity of *Glossina palpalis* fed on sleeping-sickness patients under treatment.—Colonel Sir D. **Bruce**, F.R.S., and Captains A. E. **Hamerton**, H. R. **Bateman**, and F. P. **Mackie**: Experiments to ascertain if *Trypanosoma gambiense* during its development within *Glossina palpalis* is infective.—Captain R. **McCarrison**: Further experi-

mental researches on the etiology of endemic goitre.—H. Hamshaw **Thomas**: The leaves of Calamites (Calamocladus section). Most of the material investigated originally came from the Halifax Hard Bed of the Lower Coal Measures. Most leaves were very small, being only 1–2 mm. long and 0·8–1 mm. broad. They are falcate in shape, and were borne on slender twigs in alternating whorls of four. The structure of these slender twigs differs somewhat from that of the young Calamitean stems already described by Williamson and others, but it may be compared in some features with the structure of the young stems of some modern Equisetums. The tissues of the small leaves show a concentric arrangement. In the centre there is a vascular bundle consisting of four or five small tracheides, surrounded by thin-walled elongated cells. The bundle is surrounded by a zone of cells with dense black contents, termed by Hick the melasmatic tissue, and is probably comparable with the bundle-sheath of the leaves of modern plants. The cells of the palisade-like assimilating tissue abut on to this; they have large spaces between them. The epidermis is thinner on the concave side of the leaf, and the stomata are situated on this face only. The latter are characterised by transversely striated guard cells, similar to those seen in many species of modern Equisetums. These leafy twigs seem to be identical with the impression species *Calamocladus charaeformis* (Sternb.); their structure seems to indicate that they grew in a pendulous manner. Specimens have been obtained showing variations in structure from the normal type. Four other types of leaf have been discovered differing in size and in arrangement of tissues. In all of these there is a very conspicuous strand of sclerenchymatous fibres running up the adaxial side of the leaf, and forming a large part of its apex. These fibres become more conspicuous in the longer leaves. In some types the thin-walled (phlœm) tissue of the bundle is much reduced, or even absent. The melasmatic tissue also varies considerably in amount. Some of these longer leaves were probably identical with *C. grandis* (Sternb.), others with *C. equisetiformis* (Schloth.). They are characterised by a more compact structure, with smaller and fewer intercellular spaces. The structure of the smaller leaves probably indicates that they grew in a moist situation, or where the atmosphere was humid. The larger leaves are more xeromorphic in character. The results obtained from this work indicate that the Calamites were truly microphyllous.—Dr. J. O. Wakelin **Barratt**: Complement deviation in mouse carcinoma. The object of the present investigation is to ascertain if in mouse carcinoma antibodies are produced in respect of the tumour. The method followed is an application of the complement deviation test, an extract of mouse tumour being employed as antigen. The experiments made fall into two groups. In one the serum of the rabbit or of man was employed as the source of complement; in the other the serum of the mouse served as the source of complement. In both cases the same result was obtained, namely, that the complement deviating power of the serum of mice with tumours was sometimes greater than that of normal mouse serum, but not unfrequently the serum of a mouse with a tumour was found to be identical in respect of its complement deviating power with that of a normal mouse.

Linnean Society, January 19.—Dr. D. H. Scott, F.R.S., president, in the chair.—C. H. **Wright**: Flora of the Falkland Islands. An endeavour has been made to define the distribution of plants in the islands and to show what changes have taken place in the flora since the publication of the "Flora Antarctica" in 1847. The plants are chiefly of dwarf habit, often with aromatic leaves, and conspicuous, often scented, flowers, which are produced chiefly between November and January. The earliest to appear is *Draba funiculosa*, Hook. f., in September. The extermination of the fox (*Canis antarcticus*) has rendered possible the keeping of sheep, with the result that plants previously common have now become rare; amongst these are the tussac grass (*Poa flabellata*, Hook. f.), cinnamon grass (*Hierochloe redolens*, R. Br.), and blue grass (*Agropyron repens*, Beauv.). *Primula farinosa*, var. *magellanica*, Hook. f., while still abundant, is much dwarfed in those islets where sheep have been introduced. *Veronica elliptica*, Forst. f., attains a height of 7 feet, and is the tallest plant on the islands, the next being *Chiliotrichum amelloideum*, Cass. (the Fâchima plant). *Azorella caespitosa*, Cav. (the balsam-bog), forms hard masses up to 10 feet long and 4 feet high, which rapidly decay on being wounded. The flora shows a great affinity with that of Magellan and Chile.—C. **Crossland**: The geological and geographical position of Khor Dongonab.—Mr. Hugh Scott summarised the following five reports:—R. E. **Turner**: Fossorial Hymenoptera. The author enumerates twenty-five species, of which thirteen are from the Seychelles, eleven from Aldabra and the adjacent islands, while one (a common Eastern form) was only found in the Chagos.—Prof. J. J. **Kieffer**: Two families of Diptera, the Cecidomyiidæ (gall-flies) and the Chironomidæ. No species of either family has previously been recorded from the Seychelles, and they have been but little collected in the tropics as a whole. Hence it is not very surprising that the twenty-four species of Cecidomyiidæ and the forty-eight species of Chironomidæ described in these papers are all new. The Cecidomyiidæ all belong to genera which are not usually gall-formers; the Chironomidæ, with one exception, all belong to European genera, and forms of larger size are absent. These families cannot at present throw much light on the affinities of the Seychelles fauna as a whole, owing to their not having been much studied in other lands in the same region, but it is of great importance that one should begin to gain some knowledge of their representatives in such places as the Seychelles.—Dr. K. **Kertész**: Report on a family of Diptera, the Stratiomyiidæ. This deals with nine species, of which two are new to science; two new genera are also described, one being established to receive an already known species. Of the seven species of Stratiomyiidæ from the Seychelles and Aldabra which are not new, one is also known from Madagascar, and the other six from various Eastern localities, such as Cocos-Keeling and various islands of the Eastern Archipelago so far as the Philippines.—E. **Meyrick**: Microlepidoptera of the groups Tortricina and Tineina. The author states that in these groups the Seychelles and Aldabra faunas must be considered separately. From the Seychelles he recognises 111 species, of which twenty-one are almost certainly imported, while the remaining ninety are probably endemic. These ninety consist in part of an "ancient but highly specialised fauna," analogous to the somewhat similar, but more primitive, fauna found in Mauritius and Réunion, and in part of forms which may have been derived sporadically from various parts of the Indian region. Among the material from Aldabra, Mr. Meyrick recognises nine species, all new, but belonging to widely distributed genera.

Mineralogical Society, January 24.—Prof. W. J. Lewis, F.R.S., president, in the chair.—F. H. **Butler**: Kaolin. The kaolinite in the Glamorganshire Coal Measures originated in the decomposition of felspar by carbonated underground water. The secondary mica and quartz of the Carboniferous grits and greisens are due primarily to the formation of potassium carbonate and alumohexasilicic acid (Morozewicz), the acid breaking up into silica and alumdisilicic acid (*i.e.* kaolin less water of crystallisation), and the latter combining with the carbonate to yield muscovite and free carbonic acid. Kaolinite is destroyed concurrently with the growth of schorl in kaolin rock, and cannot, therefore, be a product of boration.—Dr. G. T. **Prior** and Dr. G. F. H. **Smith**: Schwartzembergite. Analyses recently made by the former show that this mineral is a complex iodate and oxychloride of lead, $Pb(IO_3)_2.3[PbCl_2.2PbO]$.—A. **Hutchinson**: An improved form of total reflectometer. The instrument is a goniometer of the suspended type with a large base plate, to which a telescope and collimator, a microscope bisecting the angle between them, and other apparatus can be clamped, and is intended for the measurement of minute crystals, and for the determination of the optic axial angle of biaxial crystals, and of the refractive indices by Kohlrausch's method.—T. **Crook**: A case of electrostatic separation. The apparatus consists of two copper plates, one of which is coated on one side with a layer of shellac. Good conducting minerals are attracted to the shellac-covered surface of the upper plate when it is charged by means of an electrophorus.

Institution of Mining and Metallurgy, January 25.—Mr. Edgar Taylor, president, in the chair.—*Adjourned discussion.* H. C. **Bayldon**: Notes on Chilian mills in Russia. In this paper the author provides a useful and instructive treatise on the slow-running Chilian or "Edge runner" mill, invariably used in Russia for crushing gold ores as a preliminary to amalgamation, &c. After a brief historical summary, the paper gives descriptions of the standard type of Chilian mill now in use, and of the milling methods adopted in Russia, which are followed by notes on an improved type of Chilian mill and milling plant recently introduced. The descriptions are suitably illustrated, and there are ample statistics relating to mills and their efficiency. The author is of opinion that if the same amount of thought and attention were devoted to this type of mill as has been given to the heavy stamp *plus* tube mill combination in South Africa, it would prove a serious rival and give a product nearer to the ideal aimed at on that goldfield.—N. A. **Loggin**: Notes on placer mining, with special reference to hydraulic sluicing. The author here gives the results of a wide experience in placer mining conducted on the hydraulic sluicing system in the form of a collection of practical hints with regard to the whole of the process involved, from the initial determination of the value of the gravel to be mined down to the most suitable location of the dump. As might be anticipated, the chief points dwelt upon relate to the arrangement of an efficient supply of water to feed the "giants" and "deflectors" at the face of the mine, as this constitutes the *crux* of the problem, next in importance to which comes the construction of the flume in which the gravel is washed and relieved of its gold contents.

EDINBURGH.

Royal Society, December 19, 1910.—Prof. Bower, vice-president, in the chair.—Prof. A. C. **Seward**: The Jurassic flora of Sutherland. This contained a general account of the fossil plants collected by Hugh Miller, Dr. Marcus Gunn, and Mr. Archer from the Kimeridgian strata on the coast of Sutherland. Dr. Gunn's collection has been recently acquired by the British Museum. Thanks were expressed to Mr. H. B. Woodward for notes on the geology of the Sutherland plant beds. The flora of Sutherland, with a few types collected by Hugh Miller at Eathie (Cromarty), may be regarded as representing the Jurassic flora of Scotland as a whole, the specimens recorded from western localities being very few and fragmentary. The Scottish Jurassic flora includes several widely distributed species previously described from the Inferior Oolite series of Yorkshire and elsewhere, together with some Wealden types. From a botanical point of view, the Kimeridgian flora of Sutherland is interesting chiefly on account of the additional evidence it affords of the general uniformity of the Jurassic vegetation of the world, and as demonstrating the occurrence in north-west Europe in the Jurassic era of such genera as Hausmannia, Laccopteris, Araucarites, &c., which are now represented by species in the southern tropics or in south temperate latitudes.—Dr. A. A. **Lawson**: Phase of the nucleus known as synapsis. The argument was that synapsis was due, not to contraction, as generally supposed, but to growth.—Prof. R. J. A. **Berry**: The sectional anatomy of the head of the Australian aborigine.

January 9.—Prof. Hudson Beare, vice-president, in the chair.—Alan W. C. **Menzies**: A method for determining the molecular weights of dissolved substances by measurement of lowering of vapour pressure. The apparatus was so arranged that the temperature of the liquid, with the dissolved substance in it, was sustained at the temperature of the vapour coming from the boiling pure liquid, while, at the same time, part of the surface of the impure liquid was subjected to the pressure of this vapour, while the rest of the surface was subjected to the pressure of its own vapour, which was somewhat less, because of the dissolved substance. The difference of pressure was balanced by the difference of height of the two surfaces of the liquid. The method was found to be easy of manipulation, and to lead to satisfactory measurements.—Dr. George **Green**: The *modus operandi* of the prism. The action of a prism on a light "pulse" incident upon it was illustrated by means of the analogy between the pulse problem and the hydrodynamical problem presented by a point disturbance moving uniformly over a liquid surface. Taking the ship-wave pattern to represent the general form of wave disturbance within a prism immediately after the incidence of a light pulse, the author applied the theory of group velocity to arrive at the general features of the wave system after emergence from the prism, deriving the usual formula for the resolving power.—Dr. John **Brownlee**: The relation of the monomolecular reaction of life processes to immunity. The simple law of exponential decay was found to govern many of these processes. An interesting example was the mortality due to scarlet fever at different ages; the statistics for two large towns showed that this mortality amongst children diminished exponentially with increase of age.

PARIS.

Academy of Sciences, January 30.—M. Armand Gautier in the chair.—H. **Deslandres**: Researches on the movements of the solar atmospheric layers by the displacement of the lines of the spectrum. Lack of symmetry and peculiarities of the phenomenon. The author gives a short historical survey of the whole of the work done in this field, and proceeds to discuss in detail the observations made at the Observatory of Meudon from 1892 onwards. Special attention is given to the displacements of the K_3 line and the views which have been put forward to explain the observed facts.—G. **Lippmann**: The action of external forces on the pressure of saturated vapours and the gases dissolved in a liquid. The lowering of the vapour pressure of a liquid in a capillary tube was first demonstrated by Kelvin. The explanation put forward by Kelvin involves the constancy of the vapour pressure throughout the whole column of the liquid, the variation being assumed to be produced in a discontinuous manner in the meniscus. The author proposes another explanation, according to which, for equilibrium, the tension of a dissolved gas varies with the level according to the same law as the pressure of the gas in the interior of the liquid. Saturated vapour can be regarded as a particular case of this theorem.—M. **Gouy**: The existence of a periodic element in the magneto-kathodic radiation. It is known that in a high vacuum the magneto-kathode bundle emitted by a wire serving as a kathode forms a luminous sheet, separated from the kathode by a dark space. Under certain conditions, dark and light fringes appear in this luminous portion. It has been found that the maximum intensity corresponds to rays the lengths of which are exact multiples of a certain length, a, which is inversely proportional to the value of the magnetic field.—D. Th. **Egoroff**: Sets of measurable functions.—R. **Bourgeois**: A cause of an instrumental error in the measurement of a base line. In the determination of a base line at Blida, invar wires, standardised at the International Bureau, were used. Certain discrepancies appeared in the results, outside the ordinary experimental error, and these were finally traced to the inclinations of the rule from the horizontal. The error was eliminated when the measurements were made in opposite directions over the same line and the mean taken.—Torres **Quevedo**: A mechanical construction for the linkage expressed by the formula $d\beta / d\alpha = \tan \omega$.—Auguste **Righi**: The probable ionising action of the magnetic field. Some experiments are described in which the discharge potentials between metallic electrodes in an exhausted tube were measured in magnetic fields of varying strength. The hypothesis that the magnetic field can produce ions offers a possible explanation of the observed facts.—C. **Limb**: Compounding alternators by means of electrolytic valves.—E. **Urbain**, Cl. **Scal**, and A. **Feige**: A new type of arc lamp having a mercury kathode and giving white light. An arc is struck in a quartz tube between an anode of tungsten and a kathode of mercury. The light is practically white, spectroscopic examination showing a continuous spectrum with the mercury lines superposed. The yield is high (0·45 watt per candle), and the arc works with a potential difference of 12 volts; the voltage can be increased by the presence of an inert gas in the tube.—J. **Boselli**: Reaction velocities in heterogeneous systems.—Louis **Hackspill**: The density, coefficient of expansion, and change of volume on fusion of the alkaline metals. The metals (cæsium, rubidium, potassium, and sodium) were distilled in a high vacuum immediately before each

experiment and directly into the experimental tube. The expansion of the liquid metal was measured directly without the intervention of any other liquid; for the expansion of the solid, pentane was employed as the indicating fluid. It was found, incidentally, that benzene and toluene are rapidly attacked by liquid cæsium without any evolution of gas; the nature of the compounds formed is being investigated.—Daniel **Berthelot** and Henry **Gaudechon**: The photolysis of complex acids by the ultra-violet rays. The action of uranium salts as catalysers. Details are given of the decomposition products of various dibasic, ketonic, and alcohol acids when exposed to ultra-violet light. The addition of small quantities of uranium salts, without altering the nature of the gases evolved, increases the velocity of the decomposition from four to six times.—A. **Job** and P. **Goissedet**: A crystallised green manganitartrate.—E. E. **Blaise** and L. **Picard**: The action of the chlorides of the α-alkoxy-acids upon the mixed organo-metallic derivatives of zinc.—P. L. **Viguier**: α-Bromocrotonic aldehyde. A description of the products of the reaction of this aldehyde with hydroxylamine, semicarbazide, hydrazine, phenylhydrazine, and urethane.—V. **Grignard** and Ch. **Courtot**: Some new derivatives of indene.—Marin **Molliard**: Nitrogen and chlorophyll in galls.—P. A. **Dangeard**: The determination of the active rays in the chlorophyll synthesis.—Henri **Labré** and L. **Violle**: The ingestion of mineral acids in the dog. The amount of bases secreted in the urine is increased by the ingestion of hydrochloric acid.—M. **Doyon**, A. **Morel**, and A. **Policard**: A demonstration of the exclusively hepatic nature of antirhombine. The extraction of this substance by a solvent for nuclear bodies.—Clément **Vaney**: Researches on the development of *Hypoderma bovis*.—E. **Pinoy**: The form of *Sporotrichum Beurmanni* in human lesions. Its fructification in the interior of the capillaries. The visibility of the parasite is largely dependent on the exact method of staining, and it is shown that in human lesions caused by this parasite the organism is more abundant than has been hitherto supposed.—L. **Bruntz**: The physiological signification of the leucocyte reactions of infections and intoxications.—L. **Mercier** and R. de Drouin **de Bouville**: Lepidorthosis in *Leuciscus rutilus* of the lake of Nantua.—L. **Cayeux**: The existence of limestones containing Gyroporella in the Cyclades.—Louis **Gentil**: The Riffian deposits of Morocco.—Louis **Fabry**: The registration of small artificial earthquakes at a distance of 17 kilometres. Small earthquakes caused by subsidences in mining districts have been recorded on the seismograph of the Marseilles Observatory.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 9.

ROYAL SOCIETY, at 4.30.—(1) Certain Physical and Physiological Properties of Stovaine and its Homologues; (2) The Effect of some Local Anæsthetics on Nerve: Dr. V. H. Veley, F.R.S., and W. L. Symes.—(1) Experimental Researches on Vegetable Assimilation and Respiration. VIII. A New Method for Estimating the Gaseous Exchanges of Submerged Plants; (2) Experimental Researches on Vegetable Assimilation and Respiration. IX. On Assimilation in Submerged Water-plants and its Relation to the Concentration of Carbon Dioxide and other Factors: Dr. F. F. Blackman, F.R.S., and A. M. Smith.

ROYAL SOCIETY OF ARTS, at 4.30.—Indian Superstitions: R. A. Leslie Moore.

ROYAL INSTITUTION, at 3.—Problems of Animals in Captivity: P. Chalmers Mitchell, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Adjourned discussion*: Long Distance Transmission of Electrical Energy: W. T. Taylor.—Extra High Pressure Transmission Lines: R. Borlase Matthews and C. T. Wilkinson.

MATHEMATICAL SOCIETY, at 5.30.—The Application of the Mathematical Theory of Relativity to the Electron Theory of Matter: E. Cunningham.

FRIDAY, FEBRUARY 10.

ROYAL INSTITUTION, at 9.—Robert Louis Stevenson: Sir Sidney Colvin.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Rivers and Estuaries: W. H. Hunter.

PHYSICAL SOCIETY, at 8.—Annual General Meeting.—Presidential Address: The Caloric Theory of Heat and Carnot's Principle: Prof. H. L. Callendar, F.R.S.

MONDAY, FEBRUARY 13.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Further Explorations in Bolivia: Major P. H. Fawcett.

ROYAL SOCIETY OF ARTS, at 8.—Brewing and Modern Science: Prof. Adrian J. Brown.

TUESDAY, FEBRUARY 14.

ROYAL INSTITUTION, at 3.—Heredity: Prof. F. W. Mott, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: The Detroit River Tunnel, between Detroit, Michigan, and Windsor, Canada: W. J. Wilgus.—*Probable Paper*: Coast Erosion: W. T. Douglass.

WEDNESDAY, FEBRUARY 15.

ROYAL SOCIETY OF ARTS, at 8.—Modern Machine Bookbinding: G. A. Stephen.

ROYAL MICROSCOPICAL SOCIETY, at 8.—On some New Objectives and Eye-pieces by R. Winkel, of Göttingen: E. M. Nelson.—On the Recent and Fossil Foraminifera of the Shore-sands of Selsey Bill, Sussex. Addendum: E. Heron-Allen and A. Earland.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Variation of the Depth of Water in a Well at Detling, Maidstone, compared with the Rainfall, 1885–1909: R. Cooke and S. C. Russell.—The Actinograph; an Instrument for Recording Changes in Radiation: A. W. Clayden.—New Cloudiness Charts for the United States: K. M. Clark.

SOCIETY OF DYERS AND COLOURISTS, at 8.—The Enzymes of Malt, and their Employment in the Textile Industries: R. J. May.

THURSDAY, FEBRUARY 16.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Constitution of the Alloys of Aluminium and Zinc: Dr. W. Rosenhain and S. L. Archbutt.—The Production and Properties of Soft Röntgen Radiation: R. Whiddington.—Experiments on Stream-line Motion in Curved Pipes: Prof. J. Eustice.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Research Meeting. Some Antarctic Problems: Prof. Edgeworth David, F.R.S.

LINNEAN SOCIETY, at 8.

ROYAL INSTITUTION, at 3.—Problems of Animals in Captivity: P. Chalmers Mitchell, F.R.S.

ILLUMINATING ENGINEERING SOCIETY, at 8.—*Discussion* on School Lighting. Openers: Dr. James Kerr and Dr. N. Bishop Harman.

FRIDAY, FEBRUARY 17.

ROYAL INSTITUTION, at 9.—The Stimulation of Digestive Activity: Prof. H. E. Armstrong, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting. *Further discussion*: Modern Electrical Dock-equipment, with Special Reference to Electrically-operated Coal-hoists: W. Dixon and G. H. Baxter.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Uses of Chemistry in Engineering: J. Swinburne, F.R.S.

CONTENTS.

THURSDAY, FEBRUARY 16, 1911.

A PRACTICAL MODERN TREATISE ON GEOMETRICAL OPTICS.

The Principles and Methods of Geometrical Optics, especially as Applied to the Theory of Optical Instruments. By Prof. J. P. C. Southall. Pp. xxiii + 626. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1910.) Price 25*s.* net.

IT is safe to assert that this volume will at no very distant date be in the hands of every serious English-speaking student of geometrical optics. We know of no other work in the English language in which the attempt has been made to give a thorough anu systematic account of the fundamental principles and methods of geometrical optics, so far as these are necessary for dealing with the problems of the optical workshop. There are in existence several conscientious text-books of deservedly good repute, which, as Silvanus Thompson has said, serve—rather, perhaps, served—admirably to get up the subject for the tripos, and are dotted with ingenious and fascinating problems, *e.g.* to find the equation of the bright curve seen on the spokes of a bicycle wheel rotated rapidly in the sun; but these leave untouched a vast number of questions of fundamental importance to the practical optician. More recently Dennis Taylor, whose practical knowledge and experience are unquestionably of the highest order, has attempted to provide a handbook which would assist in practical lens calculations; unfortunately the methods employed are unnecessarily cumbrous, while, as originally published, the book was marred by accidental, but serious, errors. The need of such a work in English as the present has been often stated, and with sufficient emphasis; an Englishman may be pardoned for regretting that it now only reaches him from the other side of the Atlantic.

To the reader who is familiar with Czapski's "Grundzüge der Theorie der optischen Instrumente nach Abbe" and with "Die Theorie der optischen Instrumente" (vol. i.), published by the members of the Zeiss firm, a glance through the pages of Prof. Southall's volume will be sufficient to show how largely he is indebted to these works, both as regards method of treatment and detail; a debt, indeed, which he warmly acknowledges. The author exhibits, further, a wide acquaintance with recent French and German optical literature, to which most useful references are given throughout the work. But the book is no mere translation or compilation. It is a thorough, logical, comprehensive account of the fundamental principles of geometrical optics and of the theory of optical instruments, written by one who not only has an exceptionally extensive knowledge of the work done by others, but has also an unusually complete grasp of his subject and of the essentials necessary to its clear presentment.

In a work on geometrical optics nomenclature and notation are both of the greatest importance, and to these special attention has been given. The results are, we venture to think, on the whole conspicuously successful. The notation adopted is suggestive, clearly stated, agrees in most important respects with established usage, and is carefully held to throughout the work. Great assistance is given by an index and explanation at the end of the book of the symbols used. The use of thick face type to indicate points on the chief ray of a bundle is especially convenient. As regards nomenclature, it may be noted that the term pencil of rays is confined to rays in one plane, the word bundle being employed for a system of concurrent rays in space; the term "chief ray," Sylvanus Thompson's translation of "Hauptstrahl," has been adopted as denoting especially the ray which passes through the centre of the aperture-stop in an optical instrument, or, in the object space, through the centre of the entrance pupil; and the words "Eintrittsluke," "Austrittsluke," are well rendered by the terms "entrance-port," "exit-port," denoting the virtual apertures or windows which bound the field of view in the object space and image space respectively.

The general discussion of refraction through a prism or prism system is given early in the book. In the treatment much use is made of the work of Burmester. This is followed by chapters on the reflexion and refraction of paraxial rays at spherical surfaces and their refraction through thin lenses. The discussion of the relations between object and image in these simple cases leads up to the important chapter on Abbe's theory of optical imagery, of which a full account is given in Czapski's volume above referred to. In Abbe's theory the assumption is made of a point-to-point correspondence, by means of rectilinear rays, between object and image, and from this, without any hypothesis as to the image-forming optical instrument, the fundamental laws expressing the relationship between object and image are deduced, whether for a simple or a compound optical system. In his clear and full treatment of this part of his subject Prof. Southall makes great use of geometrical methods, which are, of course, specially appropriate. It is possible that some practical opticians who are unacquainted with the elements of modern geometry may find this a deterrent, but the amount of knowledge necessary is so slight and so easily acquired that it would be unreasonable to give such an objection serious consideration. The results are applied in the succeeding chapter to the Gauss system of centred surfaces.

The general discussion follows of the exact methods of tracing the path of a ray through a system of centred surfaces when the angles of incidence are not necessarily small. The computation formulæ given are those of Kerber and von Seidel, and some illustrations of their use are afforded. In the subsequent account of the approximate theory of the spherical aberrations the author has followed somewhat closely the plan adopted by König and von Rohr in the chapter devoted to this subject in "Die Theorie der optischen Instrumente." Thus the spherical aberration on the axis, distortion, astigmatism, curvature of field, and coma, are separately considered, while in conclusion a somewhat modified presentation is given of von Seidel's theory, of which an excellent account is provided in Silvanus Thompson's transla-

tion of Lummer's "Photographic Optics." A separate chapter deals with the reflexion and refraction of astigmatic bundles of rays, and in a further chapter the colour aberrations are discussed.

The last chapter, which is of considerable importance, reproduces Abbe's theory of the action of the "stops" in an optical instrument, and deals generally with questions depending on the aperture and the field of view.

The preceding notes will sufficiently indicate the scope of the book. It is confined to the discussion of general optical principles, and methods of calculation applicable to optical instruments, and does not actually deal with the application of these methods. It thus covers practically the same ground as vol. i. of "Die Theorie der optischen Instrumente" already referred to. The subtitle of that volume, "Image formation in optical instruments from the standpoint of geometrical optics," is, indeed, excellently descriptive of the present work. The range is sufficiently extensive, and it would hardly be possible, within the limits of a single volume, to include in addition the theory of lens design, or the application of the general principles to special types of optical instruments. On the other hand, a volume, or rather volumes, dealing with these applications are urgently needed. It is to be feared that there are many practical opticians in this country to whom it may appear that this work offers little of immediate practical importance, and to whom it would only be possible to work back, so to speak, to the present volume from one dealing with its immediate application to, say, the telescope or the photographic lens. It is earnestly to be hoped that Prof. Southall may be persuaded to provide them with the opportunity. There are few who have his equipment for the task, and the need is universally recognised. There can be no question that by the issue of the present volume Prof. Southall has rendered a great service to American and to English opticians.

It may be added that the general get-up of the book is excellent; the type is clear, and the figures well drawn. Some of the figures, however, would have been much improved if they had been reproduced on a somewhat larger scale.

MANCHURIA, KOREA, AND RUSSIAN TURKESTAN.

The Face of Manchuria, Korea, and Russian Turkestan. Written and illustrated by E. G. Kemp. Pp. xv+248+xxiv plates. (London: Chatto and Windus, 1910.) Price 7*s.* 6*d.* net.

THE facilities afforded by extended railway communication to remote regions of eastern Asia have rendered it possible for the leisured tourist to travel safely, and with comparative comfort, from Russia to the seaboard of Asia on the east in a direct line traversing a vast area, a great part of which still remains unexplored, especially in Korea and Russian Turkestan, although excellent work has been done within the last decade by intrepid travellers in crossing the deserts, and surveying the mountain chains in which this part of Asia abounds. Judging from previous work, the author, as an expert tourist, has had some useful training, and has not wholly confined descriptions of the route to the face of things, but has invested the work with unusual interest by historical and other notes concerning the races inhabiting the countries traversed. Four months covered the outward and return journeys, following the lines of the Transsiberian Railway, and onward by connecting lines to Korea, and home again.

The result is the volume under review, which forms an attractive addition to tourist literature, a picturesque guide-book so agreeably written as to captivate the reader who has neither time nor opportunity to follow in the author's footsteps. The historical notes are discriminating and sufficient for the purpose, while the accounts of various regions and races inhabiting them, their religion, social condition, &c., are not without interest. The political outlook created by the new alliance of Russia and Japan is painted in sombre colours. The Japanese determined by force, if necessary, to coerce the Chinese into throwing Manchuria open to Japanese colonisation, and the attitude of China to resist advances. On the other hand, there is Russia's demand to construct and control a railway direct from Irkutsk to Peking, and to prevent the Chinese running a line into Mongolia.

The position created for China is therefore not without the gravest peril, and in the future may lead to serious complications in view of China's progress as a military Power. The author acknowledges indebtedness for trustworthy information supplied along the route. The line into Manchuria joins the Transsiberian Railway with the continuation of the line to Mukden and Peking, enabling the traveller to reach the Chinese capital, starting from London, in about seventeen days. The Japanese appear to have been forestalled in their desire to colonise Manchuria, as the country is being rapidly overrun by Chinese immigrants, owing to its great fertility, and affording an excellent home to the settlers, who are more prosperous than elsewhere in the empire.

The first section of railway to Kharbin is under Russian control, having soldiers posted at intervals all along the line. Half-way from Kharbin to Mukden it becomes Japanese, having military officers on board the trains. The author's brief historical note on Manchu history may be rendered all the more interesting by a perusal of Mr. Meadows's "History of the Manchus." It goes back to the eleventh century B.C., and is full of adventure, enterprise, and war up to 1644, when the Manchus conquered and founded the present dynasty as rulers of China, when they settled down, adopting Chinese methods of government.

Mukden, the Manchu capital, a picturesque and famous old city, is visited and described. It has fallen into decay, although not without signs of renewed life by the transforming influence of the West. The old palace museum contains perhaps the finest collection of ancient Chinese bronzes and porcelain that exists. Some account is given of the Boxer rising and ravages. The hospital of the missions was wrecked, but has been rebuilt, and we are pleased to note that the Viceroy has promised to contribute 48*ol.* annually in support of this beneficent institution. The

author's experiences in Korea are not the least interesting part of the book. Korea proves a most successful mission field in the East. The annual native contribution to the missions is estimated at 25,000*l*.

The quaint city of Seoul, under Japanese rule, leaves no doubt in the minds of visitors of the thoroughness of their governing methods as carried out in minute detail. One of the most serious losses sustained by the Koreans was the death of the wise Prince Ito, their governor. It was discovered when the murderer of the Prince was condemned to death that he was writing a poem, and the Japanese judge with grim humour, or Confucian regard for literature, granted him ten days' grace in order that he might finish the effusion.

We must now leave the reader to follow the author through Russian Turkestan, and in connection with this part of the route he might consult Dr. Stein's account of his recent exploration and wonderful discoveries in the Turkestan desert, and Mr. Carruthers's recent survey in the mountain region peopled by the Kurghiz. The author's attractive sketches add to the value of the book.

J. T.

VARIABILITY IN "LOWER" ORGANISMS.

Die Variabilität niederer Organismen. Eine deszendenztheoretische Studie. By Hans Pringsheim. Pp. viii+216. (Berlin: Julius Springer, 1910.) Price 7 marks.

THIS book is an attempt to analyse and correlate the known facts regarding variations in certain so-called "lower" organisms. Among these, the Bacteria occupy the chief place, although the Fungi—especially the Saccharomycetes—and the Protozoa are also considered to some extent.

To anyone acquainted with the present state of the literature of this subject, it is unnecessary to point out the difficulties entailed in writing a book of this sort: yet from the admirably clear and concise manner in which the author has presented the facts, the average reader will obtain but a very faint idea of the large amount of patient labour which has been devoted to the task. Perhaps no greater praise could be given to a work of this sort—a work which is unique in that it attempts to correlate the variability of unicellular organisms with that of "higher" forms, and thus to supply biological facts in place of the *a priori* notions which are usually given regarding the "lower" organisms when considered in relation to the theory of organic evolution.

As a compilation of facts, the work leaves little to be desired. The omissions are, for the most part, unimportant. With the author's analysis and interpretation of the facts, however, we by no means always agree: but it is impossible to discuss these properly in a few words, as almost every paragraph in the analytical sections contains a significant idea. By the admirable method which the author has adopted of relegating the literature references and details to a separate section—thus eliminating a large mass of facts of great, but secondary, importance from the main body of the text—a very clear and readable statement of the facts and arguments has been achieved.

The author begins with a brief consideration of the significance and causes of variability in general, and of the heritability of variable characters. It may be noted that the term *mutation* is rejected, and the variations of "lower" organisms are designated *fluctuations*, when they arise from internal causes, and *adaptions* (*sic*) or *accommodations*, when they are called forth by external influences. After some discussion of the struggle for existence in "lower" organisms, and of the limits within which variations occur, the author passes to an enumeration of the observed facts regarding variations in these forms.

As already noted, most of the facts are derived from the Bacteria. They therefore relate chiefly to physiological variations. The author describes variations in colony formation, optimum growth temperature, motility, spore formation, metabolism, ferment and colour production, virulence, and a number of other variable characters. Morphological variations—arising naturally, from innate and unknown causes, or produced by temperature changes, poisons, &c.—are also briefly considered: but pleomorphism is dismissed in a few words, as the author regards it as a normal event in the life-cycle of those forms which display the phenomenon, and therefore properly to be eliminated from a discussion of true variations.

The author's general conclusions naturally constitute the chief feature of interest in the book. He believes "that all the observed cases of variability in micro-organisms may be interpreted as fluctuating variations" (*i.e.* arising from unknown and innate causes) "and functional adaptations": and further, that "there are heritable and non-heritable fluctuating variations in micro-organisms, just as in highly developed animals and plants."

Finally, the author considers the bearing of the facts upon Weismann's view of the relation between amphimixis and variability. From the recorded observations on the variability of "lower" organisms, he concludes that no reasonable grounds exist for supposing that amphimixis causes increased variability in the organisms possessing it, because a high degree of variability is found in non-sexual "lower" organisms which multiply by simple fission.

"One of the chief advantages of amphimictic reproduction is the exclusion of the inheritance of acquired characters and the enforced equalisation of the variable characteristics of special individuals."

A detailed criticism of this important work is not possible in the short space allotted to the present review. We would point out, however, that our chief personal criticism concerns the author's point of view—implied in the title of the book, and impressing itself upon all the author's biological ideas. We do not regard the so-called "lower" organisms as beings which are nearer the beginnings of life than the so-called "higher" forms. The Protista—even the Bacteria—display considerable morphological differentiation, and a physiological complexity which is not "low" in any sense. We believe that a much profounder analysis of fundamentals is required than that given in this book. It is also our opinion that the

non-sexual nature of unicellular organisms—tacitly assumed by the author—must be considered in an analysis of this sort. The majority of Protozoa present sexual phenomena in their life-histories, and sexual processes also occur in many yeasts. Although we believe that the Bacteria are truly non-sexual, we think that the possibility of amphimictic processes occurring in this group should at least have been considered, as a certain amount of work has already been published in this connection.

C. Clifford Dobell.

BIOCHEMISTRY OF FATS.

Monographs on Biochemistry. Edited by Prof. R. H. Aders Plimmer and Dr. F. G. Hopkins, F.R.S. The Fats. By Prof. J. B. Leathes. Pp. ix+138. (London: Longmans, Green and Co., 1910.) Price 4*s.* net.

PROF. LEATHES'S former book on the "Problems of Metabolism" proved him to be a writer with originality in his views and a capacity for stating them in a lucid and convincing manner. One therefore turned to his long-promised monograph on the fats with considerable interest, especially as the subject is one to which he has devoted so much experimental research work.

The first hundred pages are devoted to a description of the chemistry of fats and their constituents, and the various methods for separating, identifying, and analysing them. This section of the book is useful and necessary; the facts, moreover, are clearly put and well arranged. But this laying of the foundations affords little scope for the thinker, and no doubt could have been equally well done by any competent chemist. The real interest of the book is the superstructure built upon this, namely, the chapter on the physiology of the fats, and one's only regret is that it occupies only eighteen pages. Here the author is able to display his gift of making the dark ways of metabolism as plain as is possible with our present knowledge, and in suggesting explanations and stimulating research on the questions which are still largely hypothetical.

One word of criticism of a quasi-adverse kind appears to be necessary, and that relates to what, after all, is not the most important matter, namely, that of nomenclature. The Chemical Society has laid down certain rules for nomenclature in order to ensure uniformity among English-speaking chemists; such terminations as in, ine, ol, ole, ase, &c., have definite meanings assigned to them, and surely all writers should endeavour to follow the laws put forward by the society, which occupies the foremost place in the chemical world. Prof. Leathes, however, speaks of lecithine, cerebrone, nucleine, jecorine, &c., and the substance he terms phlorrhizine is recognisable, though this spelling does not occur so far as one knows in any other English chemical book.

He has also introduced an entirely new nomenclature for the principal lipoids, the phosphatides being dubbed phopholipines, the galactosides galactolipines, and the basic constituents of galactosides lipines.

A new nomenclature is always sure to cause confusion, especially among students, and so should never be introduced without careful consideration and with some prospect that it will at once "catch on," because it is manifestly appropriate. Prof. Leathes has no doubt very carefully considered his new terms, and everyone will agree with him that the existing terminology leaves much to be desired; but it is very doubtful whether his new terms are better than the older provisional names. The chemical constitution of most of the substances in question is still a matter of doubt and speculation. The proper time to introduce new names will be when their constitution is fully known, and terms can then be framed which will express their structure with accuracy. At present Prof. Leathes has only introduced a new set of provisional names, which, like the older ones, will disappear when our knowledge is more exact.

W. D. H.

BIRD OBSERVATION.

Unleitung zur Beobachtung der Vogelwelt. By Dr. Carl Zimmer. Pp. iv+134. (Leipzig: Quelle and Meyer, 1910.) Price 1.25 marks.

THE author of this work is Dr. Zimmer, keeper of the Royal Zoological Museum in Breslau. On the first zoological excursion he undertook with his pupils in the university of that town (where he is also lecturer, as well as museum custos) they fell in with a chaffinch singing in a tree. On his demanding from them the name of the songster, the word "nightingale" was ventured on after a prolonged silence! The little episode, which indicated, to his surprise, their lamentable lack of knowledge of the commonest local birds, induced Dr. Zimmer to prepare this *büchlein* as an introduction to ornithological observing. In some respects it reminds one of the section in "Hints to Travellers," issued by the Royal Geographical Society on the same subject, though directed to a somewhat different class of observers. One, however, lays the book down with the somewhat unsatisfactory feeling that it is assumed that the student will be *made* into an ornithologist by following the instructions—all of them excellent and the result of experience—therein contained, rather than that the observer, who must be born so, and is already, if that be his bent, an ornithologist, in embryo, before he is aware of it, requires proper guiding only.

Many of Dr. Zimmer's hints will assist in directing the young ornithologist's earlier methods, and suggesting interesting lines of observation, and so will be of considerable value. After some words of introduction, the author gives a list of helpful books on ornithology, especially those with good illustrations, in English as well as German. His next section deals with the subject of excursions into "the open" in quest of birds in their wild state—"the study of cage birds is a make-believe"—and the periods of the day when they can be observed to most advantage. The most suitable field-glasses for the purpose are described.

The larger portion of the book discusses bird life at the different seasons of the year, and directs atten-

tion to what should specially be observed during each of them. In spring to love-making, song, and nidification, in summer to incubation, nestlings, with their succession of plumages, and in autumn and winter to the congregating of birds in flocks, and to migration and the migratory instincts and such like. A further section is devoted to the added help to field observations to be obtained from the study of cage birds, and to the protection of birds by artificial nests, and in protected woods. The formation of collections, the methods of preserving eggs, skins, and skeletons, the description of the proper instruments for the purpose, and suggestions on the making of anatomical, systematic, faunistic, and specific observations occupy the penultimate sections. The final pages supply some hints on bird observation abroad.

The volume is illustrated by excellent blocks, many of them being reproductions of Kearton's well-executed photographs. There is also a good index.

ELECTRICAL ENGINEERING.

(1) *Electric Circuit Problems in Mines and Factories.* By E. H. Crapper. Pp. viii+159. (London: Colliery Guardian Co., Ltd., 1910.) Price 3s. 6d. net.

(2) *Exercises in Electrical Engineering for the Use of Second-year Students in Universities and Technical Colleges.* By Prof. T. Mather, F.R.S., and Prof. G. W. O. Howe. Pp. v+71. (London: E. Arnold, 1910.) Price 1s. 6d. net.

(1) THE publication of this little volume is very opportune. Although the matter does not differ essentially from that found in other books on electrical testing of circuits, the manner of presenting the subject is admirable, and particularly well adapted to the class of reader for which the book is intended, namely, the colliery or factory engineer. There is no padding and unnecessary scientific verbiage, but directness of treatment, which must be welcome to the busy engineer. In this sense the treatment may be called popular; there is only little mathematics used, and that is of an elementary character, yet there is no sacrifice of scientific accuracy.

After a short chapter dealing with the units of measurements we get a chapter on the determination of insulation resistance, including tests on live systems. Here the author might with advantage have included Russel's and other tests on three-wire systems. The following chapter, called "Circuit Testing," is mainly concerned with the location of faults on cables by bridge and potentiometric methods, the latter being preferred by the author. Then we come to the construction of cables, and what the author has to say on this subject is well worth reading.

Finally, there are some chapters on polyphase apparatus and working. The only adverse criticism which the present reviewer has to make is as to the appearance of this little book. To present so much excellent matter in so poor a guise is not doing the author justice. The paper is too thin and the illustrations are not neat. They are also of varying style, sometimes to a large scale, sometimes with fine lines, then again to a small scale, or with unnecessarily thick lines, making no distinction between lines that are intended to represent bodily objects, and others that are merely diagrammatic. These may seem unimportant matters to the reader who sits comfortably at his well-lighted writing-table, but let him take the book down a mine to consult it while he is making a test and he will begin to appreciate thick and non-transparent paper, large type, and a systematic method in illustrating electrical connections.

(2) In this little book the authors have collected the problems and exercises set in recent years at the Central Technical College, both as regards class work and examinations. All teachers know how important exercise classes are, especially if they are conducted in a similar manner to the everyday work of the practical engineer. Now in practical work problems seldom present themselves in the definite manner in which they must necessarily be given as examples in the lecture-room; the practical problem is often involved or obscured by side issues and part of the work of the practical man is to disentangle it and separate that which really is of importance from that which is merely a small disturbing influence, or without influence at all. To present to students exercises precisely in the same way as problems arise in practical work is, of course, impossible, for it would make the questions too long, but the authors have gone as far in this direction as may reasonably be expected. The questions are such that some preliminary consideration is required on the part of the student before he can translate the wording into mathematical form, and that is excellent training for his future work.

The 427 questions contained in the book are arranged in twenty-four chapters, ranging from the elementary conception of electric circuits to machinery and apparatus in practical use. Not all the questions are set in such way that a numerical answer can be given, many can only be answered in a general way, and these are specially useful, because of forcing the student to think instead of merely to calculate by some rule learned in the lectures or copied out of an engineering pocket-book. Where numerical answers are required the solution is given in an appendix, but the authors recommend that this appendix shall only be consulted after the solution has been found, not before. Some chapters would be the better for a more extended range of problems. Thus in the chapter on commutation we miss the subjects of influence of speed, brush contact resistance, and interpoles, while great stress is laid on shifting of brushes. But nowadays most machines do not require this shifting of brushes, sparkless commutation being obtained by interpoles, contact resistance, or some sort of compensating and commutating winding. Again, in the sections dealing with A.C. generators and transformers, nothing is found on the subject of heating or the predetermination of the inductive drop. The nomenclature is also peculiar. The authors distinguish alternators as of the "copper type," "iron type," and "inductor type." The last name is generally understood, but for the first two it would be better to retain the usual designation, namely, "without iron" and "with iron" in the armature. These are, however, quite minor blemishes; on the whole the

authors have given us an admirable collection of exercises, and if students will take the trouble to work through these 427 questions conscientiously they will find it excellent training for the solution of practical problems. GISBERT KAPP.

ASPECTS OF DARWINISM.

(1) *Darwinism and Human Life. The South African Lectures for* 1909. By Prof. J. Arthur Thomson. Pp. xii+245. (London: Andrew Melrose, 1909.) Price 5*s*. net.

(2) *Darwinism and the Humanities.* By Prof. James Mark Baldwin. Pp. xi+125. Second edition. (London: Swan Sonnenschein and Co., 1910.) Price 3*s*.

(1) PROF. J. ARTHUR THOMSON is well known as one of the ablest and most judicious of recent critics of the Darwinian position. Fully appreciative of the extraordinary value of Darwin's contribution to evolutionary theory, he is yet ready to give an impartial hearing to all genuine investigators in the field of bionomics, whether their results appear to be favourable or adverse to the views advanced by Darwin. Like some other writers who strive to maintain a candid and unbiassed attitude in the face of conflicting opinions, he is liable to the usual penalty of open-mindedness; the imputation, that is to say, of indecision—in homely phrase of "running with the hare and hunting with the hounds." Such an imputation, if meant as a reproach, would be in Prof. Thomson's case undeserved; if intended as a tribute to his faculty for seeing both sides of a question, it would be justified.

The present volume, which is a reproduction in permanent form of a series of lectures delivered under the auspices of the South African Association for the Advancement of Science, is a good example of the author's skill in popular exposition. He does not shirk difficulties, but deals with them in a lucid and popular manner. In most respects he may be trusted as a faithful interpreter of the views botn of Darwin and of his successors; here and there, however, in our opinion, he goes somewhat astray. A notable instance of this is his treatment of Darwin's term, the "Struggle for Life." There can be no reasonable doubt that the leading idea in the mind of the originator of the phrase was competition—mainly between organisms of the same kind. Nothing is gained, and some confusion is introduced, by enlarging the conception so as to include resistance to adverse external conditions, or the strife between carnivorous animals and their prey. The evolutionary significance of these latter phases of organic existence lies in the fact that they necessitate competition, whether active or passive, and consequent selection, between generally similar individuals exposed to their influence. Here, in our opinion, Weismann, Haeckel, and Ray Lankester are right, and the author of "Darwinism and Human Life" is wrong.

On the question of the transmissibility of acquired characters or "somatic modifications," Prof. Thomson takes the line (and indeed he could scarcely do otherwise) that "we do not know of any clear case which would at present warrant the assertion that a somatic modification is ever transmitted from parent to offspring." At the same time he fully recognises that these somatic modifications are very common, that they are of much individual importance, that they may have an indirect influence through the body on the offspring, and, in short, may exercise an indirect control over evolution in several ways. But he rightly denies that evidence exists of their influencing the germ-plasm in a specific or representative manner. That the germ-plasm can in certain cases be permanently altered by external conditions artificially induced was surmised many years ago by Weismann (for *Chrysophanus phlaeas*), and shown by Fischer (in *Chelonia caja*). The same fact has now been demonstrated on an elaborate scale by the careful experiments of Tower on Leptinotarsa. But it is hardly necessary to point out that these results go no way towards proving the "Lamarckian" contention.

Not the least interesting passages of Prof. Thomson's book are those in which he deals with the relation of Darwinism to social and political questions. But the bearing of the doctrine of natural selection on human affairs in the widest sense receives a still more thorough and extended treatment in Prof. Mark Baldwin's volume, entitled "Darwin and the Humanities," of which a second edition has lately been published (2). The special value of Prof. Baldwin's contribution to Darwinian literature lies in the fact that he is not primarily a biologist with an interest in philosophy, but a philosopher who seeks in biological data the suggestion and justification of his philosophical method. Hence the importance of his conviction, reiterated in the course of the present and other treatises, that "natural selection is in principle the universal law of genetic organisation and progress in nature—human nature no less than physical nature." This, he affirms,

> "is the conclusion to which the lines of evidence we now have distinctly point; and while this has somewhat the appearance of a forecast, it is one of those reasonable forecasts which give life and interest to the progress of science and philosophy alike."

The application of this view to the problems of psychology, the social sciences, ethics, logic, epistemology, philosophy, and religion, is the object of the present work, which, though it is in the author's words "no more than an outline or sketch," yet succeeds in conveying in a comprehensive and effective manner the suggestion of a philosophic method in reasonable harmony with scientific facts and values.

A characteristic and consistent feature of Prof. Baldwin's conception of Darwinian theory is the emphasis that he lays on the psycho-physical character of the material presented to the operation of natural selection. Bound up with this is the recognition of mental plasticity, or, to use Sir E. Ray Lankester's term, "educability," as an all-important factor in progressive development. One outcome of the view here spoken of is the rather unfortunately named principle of "organic selection"—a principle incidentally recognised, as the author shows, by

Darwin himself, though it was reserved for later investigators to discover how powerfully it reinforced the distinctively Darwinian doctrine against Lamarckian attack.

Throughout Prof. Baldwin's work we find that his vivid realisation of the dominant fact of adaptation keeps him faithful to Darwinian standards.

"It is well," he says, "to cast about for other principles—to work out Vitalism, Mendelism, Mutationism, &c.—in those sciences which do not have to deal with the problem of adaptation, or of the accommodation of the organism through its external characters. But wherever the question arises of the relation of organisms *inter se*, and to the environing conditions of their life, the foregoing [*i.e.* variation, accommodation, selection] are not only the fruitful principles, they are the only principles we are able to consider at all."

F. A. D.

OUR BOOK SHELF.

The Manuring of Market-Garden Crops. By Dr. B. Dyer and F. W. E. Shrivell. New edition. Pp. 144. (London: Vinton and Co., Ltd., 1910.) Price 1*s.*

MARKET-GARDEN crops play a considerable part in the agriculture of districts near to towns, especially on light soils in not too high or exposed a situation. Formerly the scheme of management was fairly straightforward: the grower sent in his vegetables in carts to the early markets, sold them, and reloaded his carts with dung from the town stables with which to fertilise the next crop. But with the introduction of the motor omnibus, the motor lorry and car, and the electric tram, the supply of town dung has fallen off, so that the grower has less available and has also to pay more for it. Increasing competition from abroad has forced down the price of his produce, and has placed him in the unpleasant position of seeing his income fall while his expenses have increased. In order to meet the position he has turned his attention to artificial manures, and there is every indication that they will cheapen the cost of production.

Although a large number of experiments have been made to show the effect of artificial manures on farm crops, few, if any, had been made with market-garden crops until recently. Dr. Dyer and Mr. Shrivell have for the past sixteen years been making trials at Hadlow, the cost of which is borne by the Permanent Nitrate Committee, and have summarised their results in the little volume before us. Practically all the crops in ordinary cultivation are grown here, and as each is the subject of at least half a dozen trials, the number of plots is very considerable. At no other place in the country, so far as the writer is aware, are so many trials of market-garden crops attempted, and this furnishes the most extensive demonstration we have of what artificial manures will do in this particular direction.

The plots are intended solely as demonstrations; they do not appear to be duplicated, and no determination seems to have been made of the magnitude of the experimental error. Hence the results have no precise quantitative significance, nor perhaps was it meant they should. Their chief value is to show the grower that he is not entirely dependent on town dung, but can use a mixture of artificial manures with smaller quantities of dung than hitherto, and can get as good a crop at less cost.

Guide to the Crustacea, Arachnida, Onychophora and Myriopoda exhibited in the Department of Zoology, British Museum (Natural History). Pp. 133 + 90 illustrations. (London: Printed by order of the Trustees of the British Museum, 1910.) Price 1*s.*

THIS guide admirably fulfils its functions; it is written in a clear style, and indicates tersely the main points of interest associated with the chief families and genera. The principal characters of each subdivision—class, order, tribe, family—are concisely stated, and those of its members are singled out for mention which most aptly illustrate points in morphology or distribution, or show some striking habit. The section on the Crustacea opens with a short account of the lobster—its external features and appendages, some of its internal organs, its development, moulting, and the asymmetry of its chelæ, following which are short notes on modifications caused by parasites and on adaptation to environment.

The systematic account of the Crustacea contains a large number of interesting references to morphological and distributional points, which make it valuable apart from the special purpose for which it was prepared. To give two instances—(1) the formation of a respiratory siphon by apposition of the antennules in the Albuneidæ and of the antennæ in Corystes, and (2) the appearance of Apus in Scotland in 1907, which is ascribed to the introduction of the eggs, perhaps on the feet of birds, from the continent. The Arachnida (including Limulus and the Eurypterines) and Myriopoda are dealt with in a similarly interesting manner, and short notes are added on the Trilobita, Pycnogonida, Pentastomida, and Onychophora. A little more space might well have been devoted to the Ixodidæ in view of their great importance in connection with the spread of disease in man and animals. The figures, many of which are new, are excellent and well support the text.

Life and Habit. By Samuel Butler. New edition, with author's addenda. Pp. x + 310. (London: A. C. Fifield, 1910.) Price 5*s.* net.

PUBLISHED in 1878, this was the first—and the most important—of Butler's writings on evolution. The present volume is practically a re-issue of the original edition, though a few hitherto unpublished appendices have been added.

The central point of Butler's system—that heredity is memory—has been alluded to in our recent notice of the reprint of his later work, "Unconscious Memory"; and we may pass it over with the reminding remark that automatic action proves former practice in a pianist or knitter, therefore the apparently unpractised but perfect pecking of a newly-hatched chick proves that the chick has done it before (when it existed in the bodies of its parents) and now remembers how to do it again. This, then, is the point at which Butler continually hammers, and it brings up difficult and humorous questions, *e.g.* the question of personal identity. If a person at eighty is legitimately regarded as the same person as he was when he was an embryo, we cannot tell where to stop chasing him back, so to speak, for he is as much the impregnate ovum as he is the fœtus, and he is as much his parents, or part of them, as he is the ovum. The upshot is that all animal and vegetable life must be regarded as "nothing but one single creature, of which the component members are but, as it were, blood corpuscles or individual cells; life being a sort of leaven, which, if once introduced into the world, will leaven it altogether."

Butler was somewhat of a dilettante, and he admits, with his usual whimsicality, that he did not at first believe in his own theory!—that he only believed in

it when he gradually saw how astonishingly well it did fit the facts. But he was certainly serious, beneath his brilliant paradoxes; and, though a pariah in his own day, he is now recognised as a true if somewhat wayward and satirical genius.

Stars shown to the Children. By Ellison Hawks. Pp. xii+119+49 plates. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price 2*s*. 6*d*. net.

To give a clear, comprehensive insight into present-day astronomy, in the "Shown to the Children" series, was no light task, but in doing it Mr. Hawks has approached nearly the ideal. To children "stars" implies every extra-terrestrial orb, save the sun and moon, and Mr. Hawks exhibits his ability to reach the child even in his title.

Thus the first twelve chapters describe the phenomena of the solar system, and very brief chapters they are. Yet the juvenile reader will become acquainted with practically all the broad principles of our knowledge concerning the sun, moons, and planets, and will find in the sky a new and inexhaustible interest.

Nor can any important omission be pointed out in the eight pages dealing with comets, yet the instruction is so interwoven with interesting "story" that it is sure to be eagerly assimilated. "Shooting stars," in three pages, should lead to many a night's watch, and produce a number of recruits for the still too small army of meteor observers: the page or two concerning the Green Flash and the Northern Lights will probably not prove so fruitful.

The stars themselves occupy seven chapters, thirty-three pages, and only the most striking constellations are described and drawn; but the text is so replete with interest and star-lore that the intelligent youth will find himself forced to fill in the details. The final chapters deal with the nebulæ, the Milky Way, and the appurtenances of an observatory, and should complete the feeling of being "at home" in the young recruit.

The forty-nine excellent illustrations will of themselves command the intelligent interest of most children. In one or two places it would appear that an effort has been made to meet the child, *e.g.* on plate xxxiv. "The Mighty Hunter" need not have been drawn as the pantomimic "Bowd Slasher," and his belt should have been properly directed; but with so much to commend, these blemishes are relatively few and insignificant. W. E. R.

A Treatise on Electro-Metallurgy: Embracing the Application of Electrolysis to the Plating, Depositing, Smelting, and Refining of Various Metals, and to the Reproduction of Printing Surfaces and Art-work, etc. By W. G. McMillan. Third edition, revised and enlarged. Revised by W. R. Cooper. Pp. xv+425. (London: Charles Griffin and Co., Ltd., 1910.) Price 12*s*. 6*d*. net.

THE work of revising the excellent treatise of the late Mr. W. G. McMillan has, on the whole, been admirably done by Mr. Cooper, although there still remain a few slight errors in the body of the work which might have been corrected. For example, it is manifestly an error to recommend for nickel deposition a solution of 8 *pounds* of nickel ammonium sulphate per gallon (p. 220). Some of the recent developments in the practice of electroplating might have been given more attention, such as electrolytic methods of cleaning which of late years seem to have come into favour; and the important uses of the sand blast are still, as in former editions, almost ignored. It is, however, impossible to deal adequately within the limits of a volume of reasonable size, with all the aspects of so wide a subject, and the general excellence of the treatise in its revised and enlarged form elicits warm approval.

The section devoted to electrolytic refining is much extended, and a very good summary on the smelting of iron ores and the manufacture and refining of steel by electrical means is a new feature in this edition. There are a considerable number of useful tables given as addenda, and chapter xx. consists of a convenient glossary of substances commonly employed in electrometallurgy, with their more important properties, but the melting points of the metals might have been revised in the light of the great amount of laborious and excellent recent work done on these, such a standard temperature as silver 961° C. being given as 1740° F. (949° C.), and the ancient myth of antimony at 800° F. (427° C.) instead of 631° C.

The book must, however, be considered as a standard one on the subject, essential alike to students and practical electrometallurgists.

A. McWILLIAM.

Diptera Danica. Genera and Species of Flies hitherto found in Denmark. By W. Lundbeck. Part iii., Empididæ. Pp. 329. (Copenhagen: G. E. C. Gad; London: W. Wesley and Son, 1910.) Price 13*s*. 6*d*. net.

THE family treated in the present instalment of the "Diptera Danica" is one of considerable extent, numbering 675 palæoarctic and 440 North American species, eleven being recorded as common to both regions. The number of species described in the present volume is 164 (Mr. E. E. Austin estimates the number of British species as approximately 215), divided into five subfamilies and twenty-seven genera. The larvæ live in damp ground, under leaves, or in mud, or in decaying wood, and are believed to be carnivorous, like the perfect insects, the habits of which are very curious, as recorded on pp. 83 and 84. Sometimes the male catches an insect and presents it to the female, who sucks it during their union, and then drops it; and in other cases the male presents the female with a small dead fly enveloped in a kind of balloon of froth.

The long and detailed descriptions of genera and species appear to be very carefully written, and the 141 text-illustrations of antennæ, wings, &c., are excellent. The book deserves the patronage of all British entomologists who are interested in Diptera, especially as it is written and printed in English for their benefit. Although there are now more entomologists working at Diptera at present, the order has been less studied in Britain than any other, and we have not yet a sufficiency of works dealing with many large and important groups comprised in it.

Elementary Physiography. By Prof. R. D. Salisbury. Pp. xi+359. (New York: H. Holt and Co., n.d.)

THIS work is a reduction and simplification of the author's larger book for schools, which was reviewed in NATURE, vol. lxxxii., p. 335. It is expressly intended for schools that can give only half a year to the subject. The numerous illustrations retained will attract attention, and those dealing with types of glaciers and their products are unusually varied and effective. The Salton Sea (p. 96) has been utilised as an example of delta-flooding, and the buckling of tram-lines in San Francisco in 1906 is shown on p. 197. There is in all American work a desire to bring the present activity of the earth home to the general reader. The same spirit is seen in Prof. Walther's crusade on behalf of geology in Germany; and there are signs that the next generation will not grow up entirely ignorant of this strange rotating ball on which we live.

With the aid of maps and pictures from the British

Isles, Prof. Salisbury's present book could be utilised in English schools. Many geographical features can be best illustrated from the open lands of the United States; but the teacher will find in this volume a fair number of references to European countries. We can thus imagine a happy combination in a school course of Salisbury's Elementary Physiography" and, say, A. M. Davies's "Geography of the British Isles."

G. A. J. C.

Mentally Deficient Children, their Treatment and Training. By Dr. G. E. Shuttleworth and Dr. W. A. Potts. Third edition. Pp. xviii+236. (London: H. K. Lewis; Philadelphia: Blakiston's Son and Co., 1910.) Price 5s. net.

THE third edition of Dr. Shuttleworth's well-known and excellent handbook has the advantage of an up-to-date revision by Dr. Potts. It is not too much to say that Dr. Shuttleworth's small book prepared the way for the recent Royal Commission on Care and Control of the Feeble-Minded. The main conclusions of that commission are dealt with in the present edition. Many details from actual special schools are given. The book is indispensable to those engaged in the management and supervision of feeble-minded children. The eugenics of the feeble-minded are lightly touched upon; but, in a practical handbook, one looks rather for direction than for theory. The illustrations have been increased in number, the bibliography, already copious, has been substantially added to. There is a good index, both of subjects and of authors.

The volume as a whole is so well-balanced that it forms an excellent handbook to the study of this whole department, which, within the last five years, has grown enormously in extent and in interest.

The Flower Book: Being a Procession of Flowers, passing from Meadow and Coppice through the Hedge to the Garden, Pool, and Herb-Patch. By Constance S. Armfield. Pp. ix+153; illustrated. (London: Chatto and Windus, 1910.) Price 7s. 6d. net.

IT would be difficult to find a more direct contrast to the formal method of nature teaching than the imaginative yet fairly accurate presentation of episodes in plant-life charmingly depicted in the pages of "The Flower Book." The elements and flowers are endowed with voices to express the tale of their difficulties, their ambitions, and their victories. The distress of the stock seedlings when transplanted, the aspirations of the snowdrops and the buttercups, the spread of the pinks in the border, should appeal to the imagination of any bright child, and as natural reasons for the various incidents are cleverly worked into the arguments it may be expected that grains of knowledge will be instilled. One item calls for immediate refutation, that is, the suggested origin of the water plantain from the common plantain. There is a general theme linking together the five sections noted in the title. The illustrations are not an entire success, as some suffer from a want of proportion, but grace and truth are combined in the pictures of the rose, the bluebell, and the iris.

Hygiene and Public Health. By L. C. Parkes and H. R. Kenwood. Pp. xi+691. (London: H. K. Lewis, 1911.) Price 12s. 6d. net.

IN its original form, the first edition of this book was reviewed at length in our issue of January 30, 1890 (vol. xli, p. 290). The present is the fourth edition under the conjoint authorship; it has been carefully revised, and new matter has been introduced where necessary to bring the treatise up to date.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Origin of Incense.

IT is natural that incense should interest a botanist. For at least 4000 years mankind has used for this purpose the product of several species of Boswellia, natives of S.E. Arabia and Somaliland (the land of Punt). The English name Frankincense, borrowed from old French, substantially means incense *par excellence*, and represents the fact that, except amongst the Hebrews, it has been the substance exclusively employed in ritual. At last Epiphany frankincense and myrrh, in accordance with custom, were offered at the altar of the Chapel Royal, St. James's, on behalf of the King.

The use of incense might have originated in two different ways, and it is not perhaps always easy to distinguish these developments. Fumigation with fragrant or pungent herbs would easily arise as a sanitary expedient. The Greeks called this *θυμίαμα*, which connects with *fumus*; the plant name, thyme, derives from the same root. This, as there is evidence it did, would develop into the notion of ceremonial purification and then of consecration and honour. For such purposes it would be natural to burn frankincense on a fire-pan or censer. This was the Egyptian practice. Mr. Arthur Evans has discovered in Crete censers of Minoan age with lumps of some undetermined incense still adhering. Much of the use of incense in modern religious ceremonies has only a sanitary significance. Thus, at the coronation of George III., an official held a fire-pan on which frankincense was burnt, and this appears to have had no ritualistic meaning. It was not until the seventh century B.C. that frankincense was exported to Mediterranean countries. It doubtless carried with it is religious significance, and from this period dates the use of incense both by the Greeks and the Hebrews. That incense was of exotic origin is shown by the fact that the Hebrews called it *lebōnāh* and the Greeks *λιβανωτός*, names which, like the Arabic *lubān*, probably all derive from some local name at the place of production.

The sacrificial use of incense developed gradually and from a different source from the sanitary. Sacrifices were primarily offerings of food to the gods. It was a later development to burn them so as to present them in an ethereal form. Starting from the idea that the gods were to be propitiated through the sense of smell, frankincense was sprinkled on the burnt offerings to make them more fragrant. The latest refinement was to burn incense on the altar alone. The former the Greeks called *λιβανωτὸν ἐπιτιθέναι*, the latter *λιβανωτὸν καθαγίζειν*. Aristophanes in the fifth century B.C. carefully distinguishes (Clouds, 426) the three sacrificial acts: the sacrifice proper (*θύος*), the libation, and the addition of incense.

The use of frankincense spread to Italy, where it was used much as in Greece. The Romans called it *tus*, which is the equivalent of *θύος*. The substitution of the letter *r* in the oblique case, *tus*, *tur-is*, shows that *θύος* could not have found its way into Latin later than the fourth century B.C. In Greece *θύος* was always a sacrificial offering. Mr. Christopher Cookson, who has taken much kind trouble for me in this matter, informs me: "I can find no passage where *θύος* need mean 'incense' and many where it cannot." Now, the Romans had their own word for a sacrifice, *sacrificium*. When they began to use frankincense, instead of borrowing its Greek name, they used *tus*, the latinised form of *θύος*, substituting the name of the whole rite for that of a mere incident in it.

The confusion so produced has existed for some 2000 years. There have been several notices in NATURE of the so-called "Incense Altar of Aphrodite" at Paphos. This is apparently based on the passage in the Odyssey (8.363), where Homer calls it *βωμὸς θυήεις*. But this is merely one of his common forms. He uses it of the altar of Jupiter on Mount Ida (Iliad, 8, 48), and (Il., 23, 148) of the altar of Sperchius, on which Peleus had vowed that Achilles should offer fifty rams. It is quite true that *θυήεις* has been translated "smelling with incense"; it

really has its obvious and simple meaning of "recking with sacrifice." Virgil was, however, misled, and paraphrases the passage in the Odyssey (Æneid, I, 416) with his usual amplification into: "centumque Sabaeo ture calent arae." But it is evident that this was not accepted at the time. The elder Pliny more than once discusses the question and asserts emphatically "Iliacis temporibus . . . nec ture supplicabatur" (N. H., 13, 1, 1). Whatever, therefore, may have been the development in later times, the Homeric altar of Aphrodite at Paphos could not have been an incense-altar. It is true that it has been contended that sacrifices of blood were not offered to Aphrodite. But this is not sustainable. Victims were offered to the Paphian Venus in the time of Horace.

W. T. THISELTON-DYER.

The Electromotive Force of Standard Cells.

At the International Conference on Electrical Units and Standards, held in London in October, 1908, it was decided that the electromotive force of the Weston normal cell should be taken provisionally as 1·0184 international volts at 20° C. until further measurements, made under the auspices of the International Scientific Committee on Electrical Units and Standards, should enable a more accurate value to be assigned.

Measurements of a high degree of accuracy have now been completed, and show that the Weston normal cell made according to approved specifications has an electromotive force of 1·0183 international volts at 20° C., *i.e.* 1 part in 10,000 less than the provisional value assigned in 1908.

In consequence, the International Committee has passed a resolution expressing the desire that from January 1, and until a further recommendation, electrical standardisation in the standardising laboratories of all countries should be based on the value of 1·0183 international volts for the electromotive force of the Weston normal cell at 20° C.

Accordingly, all standard cells tested at the National Physical Laboratory will be compared with Weston normal cells of which the electromotive forces have been determined by direct measurement to be 1·0183 international volts at 20° C. These latter cells, together with new ones, will from time to time be remeasured in terms of the international ohm and the international ampere in order to ensure a constant standard of voltage.

It was assumed in the National Physical Laboratory certificates for 1909 and 1910 that the electromotive force of the Weston normal cell was 1·0184 international volts at 20° C., and therefore these certificates may be corrected for the change now introduced by subtracting 1 part in 10,000 of the value stated on the certificate.

R. T. GLAZEBROOK (*Director*).

The National Physical Laboratory, January 1.

Klaatsch's Theory of the Descent of Man.

There appeared in Nature of December 15, 1910, p. 206, a letter from Prof. Keith on Klaatsch's theory of the descent of man. As this letter is likely to give great discredit to the work of Klaatsch, in this country at least, I find myself, as a pupil of Klaatsch, justified in saying a few words more about it.

Klaatsch gives an account of his theory in a paper, entitled "Die Aurignac-Rasse und ihre Stellung im Stammbaum der Menschheit," in the *Zeitschr. f. Ethnologie*, 1910, Heft 3 and 4. After a short description of the skeleton of the Aurignac man, described by O. Hauser and himself in detail before, and after some general remarks about morphological methods in comparing the fossil man with anthropoid apes, Klaatsch goes on to consider in some detail the comparative anatomy of the humerus, ulna, and radius, and the skeleton of the hind limb of Aurignac and Neanderthal man, orang-utan, and gorilla. As Prof. Keith in his letter says that this basis is "flimsy in the extreme," we may very well examine it again. In the skull, the resemblance between Neanderthal man and gorilla (called the N.-G. group), on one hand, and the Aurignac man and orang (called the A.-O. group) on the other, is hardly visible at all, only in the supraorbital ridges there are still some traces of it. But the resemblances are very well marked in the skeleton of the limbs, especially of the arms. A superficial glance will show that the bones of A.-O. are slender, whilst those of the N.-G. are "clumsy." But this is no basis for exact scientific research; the important point is that there are differences in morphological details. The caput humeri, which articulates with the scapula, has a greater longitudinal diameter in A.-O. and a greater transversal diameter in N.-G. There is a sulcus intertubercularis between two ridges for the insertion of muscles. This runs straight down in A.-O., whilst it is somewhat **s**-shaped in N.-G. At the distal end, N.-G. shows a much greater mesial epicondyle, so that there results a sort of incision (incisura supracondyloidea, Kl.). In A.-O. the contour of the bone is much straighter; there is no sharp corner at all.

Very interesting differences are found at the proximal end of the ulna, but as this especially is a point where very detailed descriptions and technical terms are necessary, I shall pass at once to the radius. The shaft of that bone—the same holds good in both groups for the ulna—is almost straight in A.-O., but is distinctly bent in N.-G., so that the proximal and distal parts stand to each other in a well-marked angle. In the lower limbs the differences are not so well marked, although there, too, they exist. Differences are observed in the position of the trochanter major and minor, in the formation of the posterior intertrochanteric lines, in the angle between the collum (neck) and the shaft of the femur, in the shape of the malleolus and of the caput of the tibia, and so on. But they are not so striking as in the upper limb. This is quite clear, because the hind-limbs in man are highly specialised for the purpose of supporting the body, so that the influence of function is here much stronger than it is in the arms, which are free, and not always submitted to the same mechanical influences. So the differences are more hidden. But they can be seen by everyone who takes the care of studying the bones thoroughly.

I hope that even this short glance at the facts will have shown to the reader that there are two distinct groups of fossil man, the Aurignac man and the Neanderthal man, the Aurignac man resembling in many points the orang, the Neanderthal man resembling the gorilla.

In the first part of his paper Klaatsch only gives these "rather dry morphological facts." In the second part he proceeds to offer an explanation of these facts. As there is a close resemblance in morphological details of the Neanderthal race and the gorilla, and of the Aurignac race and the orang, he thinks that there must be a real blood-relation between the respective races. Klaatsch's idea, then, as to the descent of man is this. There was, originally, one group of primates, "propithecanthropoi," which, according to Klaatsch, resembled man more closely than any other now living primate. These gave origin, among others, to one group, out of which sprang the Neanderthal race and the gorilla. The Neanderthal man followed an upwards line in his development, the gorilla sank back, having become specialised in one direction, and by this being unfit for higher development. Klaatsch regards the gorilla and the other man-like apes as "failed experiments of man" (misslungene Versuche zur definitiven Menschwerdung).

In much the same way there sprang up another group, which developed into the Aurignac race and into the orang. So "the Aurignac man did not spring up from the Orang, just as the Neanderthal man did not spring up from the Gorilla" (p. 568, *loc. cit.*). How these two races of mankind reached Europe, Klaatsch tries to show in a sort of scheme, which has been published in Nature already (November 24, 1910). The Neanderthal race came *via* Africa and Gibraltar, whilst the Aurignac race came *via* Asia.

Further on, Klaatsch thinks it possible that there are races who are related in the same way to the chimpanzee and to the gibbon. Other suggestions Prof. Klaatsch makes about the existing races and the other prehistoric races. According to him, the Galley Hill and "Brünn I" skull belong almost certainly to the Aurignac race, very likely also Chancelade and Engis! As to the existing races, Klaatsch thinks to have found a relation of negroes to the Neanderthal race. Otherwise his suggestions are very hypothetical, and only meant as a working hypothesis, so that it is no good now to consider them closely.

We first have to examine the theory itself thoroughly, and then draw the conclusions.

Now, when Prof. Keith states that Klaatsch speaks about a descent of man *via* the gorilla or *via* the orang, this is wrong, as I hope to have made clear by the quotations of Klaatsch's paper. But when Prof. Keith speaks about "convergence phenomena," to which has to be ascribed a great deal, he no doubt touches the point most exposed to criticism. It is, indeed, very difficult to believe in two races, so much one like the other as man is to man, and yet so unlike in some minute morphological detail, as Aurignac is to Neanderthal, without supposing that they once were very much more unlike, and that they afterwards got more alike again by convergence. But this difficulty of Klaatsch's theory must never make us forget the facts. The problem is this. There are two distinct "races" each possessing distinct morphological characters, the one resembling the orang in these characters, the other the gorilla. How can these differences and likenesses be explained? It is certainly a very difficult problem, but a very interesting one too, that is well worthy to receive serious consideration. In any case, we must be grateful to Klaatsch for having directed attention to this fact, and for offering us an explanation—even if the latter should be only a preliminary one. GERHARDT V. BONIN.

Breslau, January 28.

WHILE admiring the manner in which Herr Bonin states the case for his Professor, I do not think he has produced any evidence that requires me to alter my statement that Prof. Klaatsch's latest theory of the origin of human races is founded on a "flimsy" basis. To understand the nature of Prof. Klaatsch's "pan-anthropoid" theory of the origin of human races, it is necessary to know the circumstances which led him to formulate it. He found that the recently discovered Quaternary individual, which he has dignified with the name of *Homo aurignacensis hauseri*—quite a modern type of man—followed closely in point of time the individual he described in 1908 as *H. moustieriensis hauseri*—a man of the Neanderthal type. To account for the manner in which these two quickly succeeding types differ, Prof. Klaatsch propounded the "theory" that the Aurignac man is descended from the orang stock, while the Neanderthal has arisen in the gorilla line of descent. Now the characters which separate those two types are exactly of the same nature and of the same degree as separate a blood-horse from a Shire stallion. Every one of the points cited to differentiate these two types of men are dependent on the degree of muscular development. Bones, especially limb bones, react sensitively to the muscles which move them; muscular impressions and processes for the insertion of muscles vary from individual to individual, and from their nature are most untrustworthy for the purpose of tracing affinities.

There is thus, in my opinion, no need to have recourse to such a theory as Prof. Klaatsch has formulated to explain the contrasted characters of the Aurignac and Neanderthal types of men; the problem is of the same nature as meets us when we seek to explain contrasted breeds among dogs and horses. Further, from a study of acromegaly, that most interesting disease of growth which I have had opportunities of examining of late, it is quite apparent that an alteration in the action of the glands of internal secretion—especially of the pituitary—will change in the course of a few years a man of the Aurignac type into one of the Neanderthal type—not an exact replica, but near enough to leave no doubt that the characters of acromegalics and of Neanderthal men are of the same nature.

Prof. Klaatsch also realised that if his theory were applicable to two races of men, it should hold true for all. Hence his suggestion that some may have arisen from the chimpanzee and some from the gibbon. His theory—a "pan-anthropoid" theory—of the origin of human races is designed to account for the various features which characterise and differentiate human races.

To those acquainted with the great mass of evidence which has accumulated in recent years relating to the structure, development, and habits of living and extinct anthropoids, Prof. Klaatsch's theory must appear altogether untenable. From 1890 to 1900 I devoted myself to an investigation of the Higher Primates, making complete dissections of more than eighty animals, and collected all descriptions which had been published at the close of that period, with the intention of tracing, from the mass of facts thus collected, the evolutionary history, not only of man, but of each of the anthropoids. An extensive analysis was made of the structural characters of each of these animal forms. Characters are found in them which also occur in lemurs, in South American monkeys, in old-world monkeys. Some characters are common to all the members of the Higher Primates (man, gorilla, chimpanzee, orang, and gibbon); others which are common to the Giant Primates (man, gorilla, chimpanzee, and orang); others which are found only in man, the gorilla, and chimpanzee; and then a considerable number which are peculiar to each member, and may be regarded as late acquisitions.

The characters I relied on were not such as Prof. Klaatsch has used—the highly variable muscular impressions on bones—they were points such as, I believe, most anatomists would regard as of morphological worth. Publication of my results was suspended owing to several circumstances; and I do not regret the fact, because since then much additional evidence has been discovered, such as the affinities shown by blood tests and by susceptibility to disease, and much of an anatomical and physiological nature, which I hope to gather and systematise. Meantime, I merely state briefly the results reached more than ten years ago. Whatever theory is propounded of the origin of the several members of the Higher Primates must account for their structural and functional characters. It is certain that Prof. Klaatsch's theory is altogether inapplicable for their explanation.

Table giving an Analysis of the Structural Characters of the Higher Primates.

Nature and Character	A Man	B Gorilla	C Chimpanzee	D Orang	E Gibbon
Peculiar to the genus (generic characters)	312	75	109	113	116
Common to A, B, C...	93	93	93	—	—
,, B, C ...	—	78	78	—	—
,, A and C..	98	—	98	—	—
,, A and B.	87	87	—	—	—
,, A, B, C, D	112	130	133	130	—
,, A and D..	56	—	—	56	—
,, C and D..	—	—	65	65	—
,, B and D..	—	73	—	73	—
,, A, B, C, D, E...	93	132	132	132	133
Common to E and A, B, C, or D	84	56	93	74	—
Common to Old World Monkeys and A, B, C, D, or E	53	144	172	213	323
Common to New World Monkeys and A, B, C, D, or E	60	33	32	38	76
Lemuroid Characters	17	41	37	50	50
	1065	1004	980	949	1002

The manner in which I seek to explain the distribution of these characters is the following. The gibbon is regarded as the representative of the basal stock of the Higher Primates, and this Hylobatian stock is looked upon as an offshoot of a basal stock (late Eocene probably), which also gave rise to the Old and New World monkeys. The distribution of characters of these groups is thus explained in the modern representatives of the Higher Primates. The evolution of the Hylobatian form marks the first and most important stage in that process which led to man's upright posture. The body of the gibbon shows all the adaptations for an upright posture (perhaps downright would be a better term) in which the weight is more suspended from the arms than supported by the legs.

The next stage in the evolution of the Higher Primates is clearly the appearance of a form which, compared to all that had gone before, may be regarded as a "giant" stock. There can be no doubt the Giant Primates (man, gorilla, chimpanzee, and orang) arose from the Hylobatian stock, and that Dryopithecus (a Miocene form) is a very good example of an early Giant Primate. The first stage in the evolution of the Higher Primates is the acquisition of a new posture, the second the acquisition of a new stature. The orang does not possess a number of characters which are held in common by man, the gorilla, and chimpanzee, and I therefore suppose that the orang

was the first to break off from the basal stem of the Giant Primates. The orang, although it has the giant size, has retained the brachiating or arm locomotion of the gibbon stock, his thumb and great toe have become vestiges; the process of shortening of the spinal column, which set in during the Hylobatian stage, has progressed, so that now the lower limbs are attached to the body one or two vertebræ higher than in man, the gorilla, and chimpanzee. It has retained a primitive arrangement of the air cavities of the nose and face, whereas man, the gorilla, and chimpanzee have the same elaborate arrangement of cells which differentiate them from all other primates.

The orang's lower limbs are in a state of retrogression—as opposite to human limbs as could be. The Aurignac man, which Prof. Klaatsch assigns to the orang stock, is remarkable for his narrow and long head, whereas the orang's head is the most rounded of all primate forms. The resemblance between the humerus of the Aurignac man and that of the orang is fanciful, in my opinion. If we may judge the basal orang stock from its modern descendants, the one thing we can be certain of is that it is the last of the Higher Primate stocks which is likely to give rise to the human race. On the other hand, the chimpanzee, and especially the gorilla, are evidently the descendants of a stock from which it is not difficult to suppose the primary human stock may have arisen. The tendency to a greater use of the lower limbs was evidently already present in that primitive stock.

The conclusion I reached in 1900 simply confirmed the statements made by Huxley in 1863.

Nothing is impossible in nature, but there are some things which are highly improbable. A multiple origin for a single species is one of the most improbable, and, so far as the human species is concerned, there is no need to suppose a multiple origin. Prof. Klaatsch's opinion of anthropoid apes throws an interesting light on his theory. He has reverted to a slight modification of the very ancient view of the anthropoids—that they are representatives of retrograde humanity. In Herr Bonin's words, Klaatsch regards the gorilla and the other man-like apes as "failed experiments of man." There is no scientific basis for such a statement—the gorilla fills its place in nature quite as satisfactorily as man.

This view of the nature of the anthropoids only affects us so far as it may help us to understand Prof. Klaatsch's theory of the "pan-anthropoid" origin of human races. If that opinion is well founded, the opinion that the Higher Primates were designed as experiments in "Menschwerdung," then, of course, it follows that the experimenter may have succeeded on several occasions, and that each of the primitive primates may have given rise to races of men. In reality, we are being again introduced to the old theory of design, and hence the statement in my last letter that Prof. Klaatsch's theory exceeded "the limits of rational speculation."

A. KEITH.

Royal College of Surgeons, England, February 4.

"In Forbidden Seas."

"D. W. T.," who writes a review of the sea-otter, or rather of a book called "In Forbidden Seas," in NATURE of January 26, tells us that he is not aware that any living naturalist has ever seen this animal in its natural state. Now, Captain H. J. Snow, who is the author of "In Forbidden Seas," is, from my point of view, a first-class field naturalist, who by his collections and observations has added considerably to zoological and geological knowledge. I may add that he is also a keen surveyor, and his maps of the islands in these "Forbidden Seas" were so far back as 1895 published for the use of sailors by our Admiralty. By the publication of these charts, the shortest routes between Vancouver and certain ports on the Asiatic coast have been freed from uncertainties and dangers. Canadian and other vessels crossing the North Pacific, in cases of emergency have new harbours of refuge which can be approached with comparative safety. Snow's charts show new rocks and shoals, take out others, adjust islands in longitude, indicate anchorages, tide rips, watering places, seal and seal-lion rookeries, and, in short, make the unknown known. Sailing directions go with the charts.

By reason of their knowledge of these Forbidden Seas and our ignorance of them, in 1855 the Russian fleet was enabled to evade that of the French and English allies. H.M.S. *Rattler* was wrecked in these seas, and the Japanese man-of-war *Tabor* was totally lost. The disabling of several gunboats which have attempted to survey these islands, and the numerous wrecks of British and other schooners which are to be found along their shores, testify to the difficulties which surround the navigation of these waters before the advent of Captain Snow. The Royal Geographical Society were so impressed by the value of his work that they awarded him one of their annual grants, and approached the Lords of the Admiralty to obtain for its author substantial recognition. Had the work been carried out by one of our surveying vessels it would have cost this country many thousands of pounds. All that was learnt was to the effect that no rule existed for the payment for work of this description. At a subsequent date the Rt. Hon. Arthur J. Balfour was approached. Among the signatories to the petition I see the name of the president of the Royal Geographical Society on behalf of the council, the Admiral of the Fleet, Rudyard Kipling, and those of many other well-known persons. Captain Snow gave up his working tools and received no recognition. I know that captains and admirals of British ships, like commissioners sent out to study seal fisheries, have sought and obtained valuable information from Captain Snow.

JOHN MILNE.

Shide, Newport, Isle of Wight, January 30.

I AM surprised and sorry that Prof. Milne should think, as he seems to do, that I sought to belittle Captain Snow's achievements, for I not only based my article on the sea-otter upon Captain Snow's additions to zoological knowledge, but I also paid an unstinted compliment to Captain Snow's romantic and adventurous career. I mentioned briefly that Captain Snow had won the reputation of an authority on the geography of the Kuriles; but that brief statement, brief because I was not dealing with, and was, indeed, very imperfectly acquainted with, his geographical work, was necessarily inadequate. Prof. Milne has done proper justice to this part of Captain Snow's work.

As regards the valuable information that Captain Snow has given to persons charged with the inspection of the seal-fisheries, I can bear testimony of my own. Still better testimony can be found, for instance, in Dr. L. Stejneger's report of 1898 on the Asiatic fur-seal islands, for Dr. Stejneger not only draws his description of the Kurile seal-rookeries chiefly from Captain Snow, but pays tribute to his "invaluable additions to the authentic history of the Kuriles," and to himself as "a man of unusual ability, literary and scientific, for the profession he had chosen to follow."

D'ARCY W. THOMPSON.

An Apparently hitherto Unnoticed "Anticipation" of the Theory of Natural Selection.

IN Louden's *Magazine of Natural History*, 1835, pp. 40–53, there appears an article entitled "An attempt to classify the 'Varieties' of Animals, with observations on the marked Seasonal and other Changes which naturally take place in various British Species and which do not constitute Varieties," by Mr. Edward Blyth. Certain passages contained therein seem to indicate that the principle of natural selection, or the survival of the fittest, was clearly understood by Blyth in 1835, and, further, that he recognised its application to artificial selection. Moreover, he demonstrates the idea of sexual selection in one of its bearings. I have therefore considered them of sufficient interest to be made public, as it appears they have hitherto escaped notice.

"When two animals are matched together, each remarkable for a certain peculiarity, no matter how trivial, there is also a decided tendency in nature for that peculiarity to *increase*; and if the produce of these animals be set apart, and only those in which the same peculiarity is most apparent, be selected to breed from, the next generation will possess it in a still *more* remarkable degree; and so on, till at length the variety I designate a *breed*, is formed, which may be very unlike the original type." . . . "It is worthy of remark, however, that the original and typical

form of an animal is in great measure kept up by the same identical means by which a true *breed* is produced. The original form of a species is *unquestionably* better adapted to its *natural* habits than any modification of that form; and, as the sexual passions excite to rivalry and conflict, and the stronger must always prevail over the weaker, the latter, in a state of nature, is allowed but few opportunities of continuing its race. In a large herd of cattle, the strongest bull drives from him all the younger and weaker individuals of his own sex, and remains sole master of the herd; so that all the young which are produced must have had their origin from one which possessed the maximum of power and physical strength, and which, consequently, in the struggle for existence, was the best able to maintain his ground and defend himself from every enemy. In like manner, among animals which procure their food by means of their agility, strength, or delicacy of sense, the one best organised must always obtain the greatest quantity, and must, therefore, become physically the strongest, and be thus enabled, by routing its opponents, to transmit its superior qualities to a greater number of offspring. The same law, therefore, which was intended by Providence to keep up the typical qualities of a species, can be easily converted by man into a means of raising different varieties; but it is also clear that, if man did not keep up these breeds by regulating the sexual intercourse, they would all, naturally soon revert to the original type. Farther, it is only on this principle that we can satisfactorily account for the degenerating effects said to be produced by the much censured practice of 'breeding in and in.' There would almost seem, in some species, to be a tendency, in every separate family, to some particular kind of deviation, which is only counteracted by the various crossings which, in a state of nature, must take place, and by the above-mentioned law, which causes each race to be chiefly propagated by the most typical and perfect individuals" (pp. 45–46).[1]

On the suggestion of Prof. Cossar Ewart, the above quotation was submitted to Mr. Francis Darwin, who has kindly informed me that he agrees with my remarks in general, but is unable to state definitely the identity of the author.

In his introduction to the "Origin" Darwin notices several such "anticipations," but no reference is made to Blyth's name in this connection.

It seems indeed strange that Darwin should have been unacquainted with this article, and, what appears stranger still, that Blyth himself should have failed to direct attention to his paper, or that there should be no mention of these passages in either Darwin's or Blyth's correspondence. Mr. Francis Darwin has, however, indicated ("More Letters," i., p. 62) that much of Darwin's correspondence with Blyth has not been forthcoming. This is to be regretted.

Curiously enough, in a letter to Lyell, Darwin says:—"Blyth says (and he is in many respects a good judge) that his ideas on species are quite revolutionised. . . ." ("Life and Letters," ii., 1887, p. 316.)

At this juncture the question naturally arises, viz., Is the Edward Blyth of the article *the* Edward Blyth of Calcutta? On turning to Grote's "memoir" (Journal Asiatic Soc. Bengal, August, 1875, part ii., supplement), we find (p. 5) that Blyth contributed to both Louden's and Charlesworth's series of the *Magazine of Natural History* from the year 1833. From the titles of the various articles which appear under Edward Blyth's name in Louden's Magazine, there is no evidence to indicate that all these contributions did not originate from the same writer. On Grote's evidence we are therefore justified in concluding that our author is the naturalist who afterwards made himself famous by his writings on, and profound knowledge of, the mammals and birds of India. Moreover, this conclusion is substantiated by our author's address, given in the same volume of Louden in several instances as "Tooting, Surrey," and we learn ("Dict. National Biog., London, 1886, vol. v., p. 276, art. Blyth, Edward) that Blyth purchased a druggist's business at Tooting on coming of age.

Mr. J. Ritchie, of the Royal Scottish Museum, has suggested to me that Blyth, in 1859, may quite easily have forgotten what he had written twenty-four years previously, the more so as he failed in the true application of his "principle." The association of his ideas with those of Darwin would, therefore, be incomplete or entirely wanting.

Though Blyth seems clearly to have recognised the principle of natural selection, he fails in its true application in that he regards *his* "principle" as operating for the conservation rather than the progression of the type, whereas the two really go hand in hand, the one being a complement of the other in the successive stages of evolution. Moreover, proof of Blyth's inability to recognise the logical issue of his theory is exhibited in some of his remarks, which appear to disagree, or are incompatible with, one another. For instance, it is hard to reconcile the sentence commencing "Farther," and ending "breeding in and in," with some of his previous statements.

Blyth was a staunch supporter of Darwin's views, and his early theorisings are of interest in connection with his projected work on "The Origination of Species," which, however, was never completed, even in manuscript form (Grote, *loc. cit.*, p. xiv). H. M. VICKERS.

81A Princes Street, Edinburgh, February 3.

[1] The italics in this quotation are Blyth's.

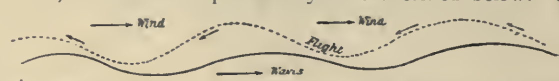
The Sailing-Flight of Birds.

IN NATURE of February 2, Mr. Mallock remarks that the skimming of some birds near the surface of the waves, where the variations in the velocity of the wind are great, may be dependent only on the inequalities of a horizontal breeze, and that an upward current is not absolutely necessary. My own observations have led me to the conclusion that whenever a bird glides for any distance without losing altitude he is, no less than the soaring kite or eagle, utilising an upward current of air. But it is possible that Mr. Mallock may be thinking of the albatross, who is perhaps without peer in his power of profiting by the vagaries of the wind. Unfortunately, I have had no opportunities of observing the albatross, and from those who have I get very conflicting accounts, some maintaining that he will glide for long distances under conditions which make it almost certain that the wind is horizontal, others holding that, though he brings the art to greater perfection, he does nothing different in kind from what the gull, that hangs with outstretched wings over the stern of a steamer, is able to achieve.

My object in writing this is to urge any of your readers whose good fortune gives them opportunities of watching the albatross on the wing to make careful observations on this very interesting subject. F. W. HEADLEY.

I AGREE with Mr. Headley that observations of the various conditions under which flight with fixed wings can be accomplished are desirable, but it is quite as important to determine the motion of the air in any particular case as to observe the behaviour of the bird.

In the case of a bird skimming close to the surface of waves, the action is presumably that sketched below. To



appreciate this properly, regard must be had to the vertical motion of the air in respect to time as well as to the wave surface. It is assumed that the speed of the wind is greater than that of the waves, and that the bird is flying to windwards. In these circumstances, the mean velocity of the air is less in the lee of each wave-crest than it is on the windward slope (indeed, when the waves are steep, the flow on the lee side may be reversed).

If a bird follows the course indicated by the dotted line, it gains, not only from the ascending current off the windward slopes, but also from the increased velocity it can acquire by dropping to a low level in the slower wind to the leeward of them.

The question of possible flight by variations of horizontal velocity has been treated by Lord Rayleigh and Mr. R. E. Froude. A. MALLOCK.

IN the flight of birds, besides the change in the inclination of the wing planes noted by the Rev. R. Abbay in NATURE of February 9, there must surely be some movement either of the wing, tail, or body which takes the place of the screw of the aëroplane. The seagull, for

instance, gives an occasional quivering motion to one or both wings which is clearly perceptible to the unaided eye, although propulsion and change of position relatively to air currents seem to be accomplished by strokes of the wings resembling sculling strokes.

It is not the birds, but certain insects, which exhibit quiverings of the wing imperceptible to the eye. The hoverer-fly, Syrphus, for example, can remain in one spot in the air while the wings are vibrating at such a rate as to be invisible, and at the approach of danger, or at will, it may suddenly by some movement, also invisible, transfer itself to a distance of a yard or more, and there continue the wing quiverings, which maintain the body almost stationary.

Is not motion in all flying and swimming things attained by presenting the wings or fins at a suitable angle to the air or water, while at the same time giving a propelling motion to the tail or dorsal fin and body, and also by a sculling motion of the wings or side fins, in the case of some insects and fishes, invisible to the human eye?

Derby, February 9. EDWARD D. HEARN.

Demonstration of Peltier and Thomson Effects.

THE following method of demonstrating the Peltier and Thomson effects may be of interest. In Fig. 1 the current passes through an *Sb-Bi-Sb* bar, the points of contact being amalgamated to reduce the resistance. Two coils of No. 36 covered copper wire are wound on the bismuth

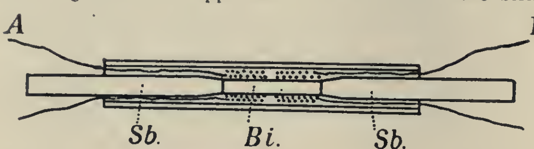


FIG. 1.

one near each junction, and by means of the leads A and B are placed in the gaps of a metre bridge, and a balance produced. On passing a current of 1 ampere through the bars, one junction is heated and the other cooled, which is indicated by a galvanometer deflection of about 40 mm. due to the change in resistance of the copper coils. The direction indicates a heating where the current flows from *Sb* to *Bi*, and *vice versa*.

Fig. 2 shows a similar arrangement for exhibiting the Thomson effect. The bent iron rod is heated to red heat at C, and the ends A and B dip into vessels of mercury,

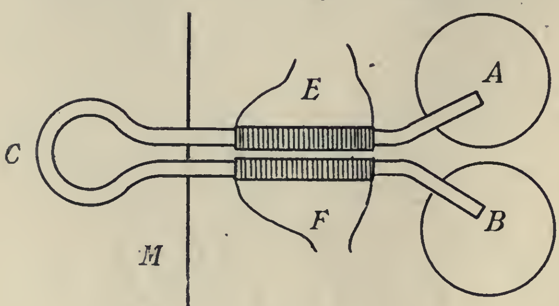


FIG. 2.

thus ensuring a large temperature gradient. On passing a current of 10 amperes in the direction ACB, AC is warmed and CB cooled, showing that the Thomson coefficient is negative. The part EF must be packed in asbestos wool to prevent heating disturbances from outside. S. G. STARLING.

Municipal Technical Institute, Romford Road, West Ham, E., January 28.

The Formation of Spheres of Liquids.

IN conducting Plateau's experiment for the formation of spheres of liquid in a medium of equal density, it is still customary to use oil of some kind in a mixture of alcohol and water. The following method will be found much simpler and more effective. A glass beaker about 10 cm. diameter and 15 cm. high is filled with water at 22° C. to two-thirds of its height. By means of a pipette, 100 c.c. of a solution of 30 grams of common salt in 1 litre of water are discharged at the bottom of the beaker, so as to form a lower layer slightly denser than the water above. A large funnel furnished with a tap, and having a stem 1 cm. or more in diameter, is now placed centrally in the beaker so that the stem terminates about 7 cm. from the bottom of the vessel. A quantity of commercial orthotoluidine, at a temperature less than 22°, is poured into the funnel, and the tap turned so as to allow the liquid to flow gradually into the water. A sphere of orthotoluidine forms on the end of the stem, the growth of which resembles that of a soap-bubble blown from a pipe.

It is quite easy in this way to make spheres 6 or 8 cm. in diameter, and the red colour of the orthotoluidine renders the procedure visible from a distance. The funnel may be lifted out and the sphere left floating in the water; and on surrounding the beaker by a square glass vessel, also containing water at 22°, the true spherical shape of the drop is seen. If the beaker be surrounded by cold water at 15°, the sphere will elongate in its horizontal diameter and sink, whereas if the surrounding water be at 27° or more, a vertical elongation will take place, and the sphere will rise and attach itself to the surface of the water in the form of a hanging drop. This behaviour is due to the fact that orthotoluidine and water are equal in density at 22°, but owing to the former liquid possessing a higher coefficient of expansion, it becomes less dense than water above 22°, and more dense at a lower temperature.

It may be added that all the usual experiments with liquid spheres can be carried out in the beaker, and the method of formation has the advantage that a sphere of any desired size may be formed by closing the tap when the requisite quantity of liquid has run out. In the course of a general investigation of liquids which are lighter or denser than water, according to temperature, the writer has found several which may be made to produce spheres at certain temperatures in the manner described, but has found orthotoluidine to be best suited to the experiment.

CHAS. R. DARLING.

City and Guilds Technical College, Finsbury, E.C.

Colliery Warnings.

I HAVE read the letters which have appeared on this subject with considerable interest. We have two theories before us. Both theories connect the presence of firedamp with changes of atmospheric pressure, but the one considers a time of high pressure as being most likely to cause an outrush of gas, whilst the other regards a falling barometer as the period of greatest danger. It does not seem at all reasonable to suppose that the atmospheric pressure would compress the rock and force out the gas as the Author of the Warnings suggests. Rather would air enter the rock cavities in such circumstances. The tendency for firedamp to escape during a falling barometer would be greater than during a rising barometer, but the evidence only shows a very slight connection to exist between the rise or fall of the barometer and colliery disasters.

The firedamp generated in certain coal measures exists in the rock, apparently, under considerable pressures, and its escape does not appear to be likely to be much affected by atmospheric pressure changes. The Author of the Warnings remarks:—"There was a time when no one guessed that the earth's surface was always on the move. . . ." In colliery districts the earth's crust is always on the move, owing to the colliery workings themselves. This movement is not a bodily oscillation—it is an actual rending of the strata for some distance below as well as above the seam being worked. Is it not likely that it is to the formation of fissures in the rock in this way that the gas owes its liberation? Considerable spaces may also be formed by the settling and creep in front of a working face; the firedamp would collect in such spaces and be forced out by further settling. At any rate, it seems clear that the escape of firedamp in quantity is more likely to be the result of some local change rather than to changes of atmospheric pressure.

R. M. DEELEY.

Inglewood, Longcroft Avenue, Harpenden, February 3.

THE OCEANOGRAPHICAL INSTITUTE AT PARIS.

THE inauguration of the Oceanographical Institute of Paris, which took place on January 23, marks not only the completion of the foundation of the Prince of Monaco's institute in Paris and Monaco, but an era in the history of the science of oceanography. If Britain led the way in initiating the systematic scientific investigation of the sea by the dispatch of the *Challenger* expedition in 1874 under the leadership of Sir Wyville Thomson, and by the publication of the results of that remarkable expedition under the direction of Sir Wyville Thomson and Sir John Murray, no country or individual has done more to establish oceanography as a science than His Serene Highness the Prince of Monaco.

Mr. J. Y. Buchanan has for so many years been associated with the Prince of Monaco and his oceanographical researches, and one sees as an outcome of his influence the present methods of the physico-chemical investigations, that are being carried out on board the *Princesse Alice,* in the museum at Monaco, and the institute in Paris. This valued help and guidance the Prince has recognised, not only conferring on Mr. Buchanan the Order of St. Charles, but also by making him vice-president of the "Comité de Perfectionnement."

Mr. Buchanan has given an impression of the life-work of the Prince of Monaco, which found expression in the solemnities[1] connected with the inauguration of the Oceanographical Museum of Monaco in April last year,[2] and it is now proposed to add a further impression of the Prince's work on the occasion of the inauguration of the Oceanographical Institute of Paris.

When the Prince commenced to build the museum at Monaco he was determined that the institution should yield the best possible scientific returns. To ensure this he has created the Oceanographical Institute of Paris, where courses of instruction to students of the university, and public lectures of a popular character are given. Thus the Oceanographical Institute is composed of (1) the "Institut Océanographique" of Paris, and (2) the "Musée Océanographique" of Monaco. The Prince has familiarly described the museum at Monaco as the workshop or factory, and the institute at Paris as the retail house. At Monaco is carried on the work of a laboratory, and an exhibition of products of the sea in an interpretative, scientific, and yet attractive manner. At Paris there are lectures and demonstrations which, it is hoped, will diffuse a taste for oceanography among industrious youths, who would ultimately complete their studies by personal research work at Monaco, and afterwards give their successors at the institute in Paris the fruit of their labours. Thus the two establishments form one institute with an unbroken interchange of work—experimental on the one hand, didactic on the other, all co-ordinated and concurrent with the same aim—the advancement of oceanographical science.

FIG. 1.—View of the Oceanographical Institute at Paris.

The institute, as has already been pointed out, is at the same time French and international. French because its seat is in Paris, with a French "Conseil d'Administration"; international because the men in whose hands the Prince of Monaco has placed the technical scientific direction are chosen from the whole world, without distinction of nationality, amongst savants who are qualified oceanographers. The Prince himself is president, Mr. J. Y. Buchanan, F.R.S., vice-president, and Sir John Murray, K.C.B., F.R.S., and the writer, are, along with Mr. Buchanan, the British representatives. Among others on this "Comité de Perfectionnement" are Dr. Jules Richard, who has so long been the chief of the Prince's scientific staff on board his ships, and who is now director of the museum at Monaco, which, as Mr. Buchanan has pointed out, owes so much to his "strenuous and unselfish work"; Dr. Paul Regnard, administrator of the institute in Paris; Prof. Dr. K. Chun, of Leipzig; Prof. Hergesell, of Strassburg; M. Forel, of Lausanne; Dr. F. Nansen, Christiania; Commandant F. A. Chaves, director of the meteorological service at the Azores, and several others. The late Prof. Agassiz represented the United States on the committee. It will be seen from these few names mentioned how international this committee is.

Situated in the heart of the Latin quarter, in Rue St. Jacque, the institute is destined to fulfil an important *rôle* in the educational life of Paris. The site chosen is the old property of the "Dames de Saint-Michel," which was acquired in 1906 by the University of Paris with the help of the State, of the city of Paris, and of the Prince of Monaco, and the university has ceded the part occupied by the institute to the Prince of Monaco.

In selecting M. Nénot as architect, the Prince has been able to combine art with science in the erection of the institute at Paris.

The central feature of the institute is a large lecture theatre, accommodating eight hundred people,

[1] NATURE, April 14, vol. lxxxiii., p. 191.
[2] *Ibid.*, November 3, vol. lxxxv., p. 7.

in which it is intended to give courses of popular lectures on oceanography. This large lecture theatre is ingeniously combined with a smaller one, which

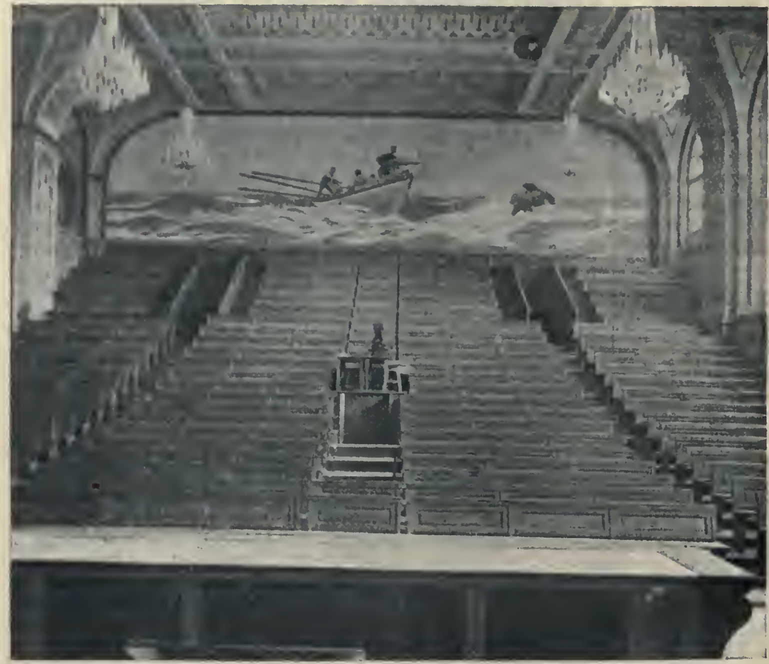


FIG. 2.—The large Lecture Theatre. View from Platform

is suited to accommodate eighty persons, and is suitable for conducting systematic scientific courses of lectures to university students. The auditorium of one theatre faces that of the other, and the screen which forms the lantern screen for each theatre, divides the one from the other. The small lecture room also forms additional seating accommodation should the large one be at any time crowded.

The administrator of the institute is Dr. Paul Regnard, who has for many years been associated with the Prince's work. His house forms part of the building, so that the administrator is always on the spot. Under him are three professors—Prof. Berget, for the study of physical oceanography; Prof. Joubain, for biological oceanography; and Prof. Portier for the study of physiology of marine animals and plants. Each professor has a very comfortable private room of his own, and attached to it a large well-equipped laboratory, with every scientific requirement, and even many scientific luxuries, including a spacious and well-fitted photographic dark room to each of the three departments. These private laboratories are each large enough to accommodate several research students if the professor of the department so desires. There are, besides, a few small laboratories, which are set apart for specialists of any nationality to carry out any special research.

There is a good library which will be subsidiary to the important library that already exists at the museum at Monaco. Two large rooms are set apart for aquaria, one contains four large tanks, and the other is to contain a large number of small aquaria, where living animals can be observed. The septic dissecting chamber and theatre forms a novel and interesting part of the institution, and close by is a crematorium for the disposal of organic waste products. There is an excellent mechanic's workshop, fitted up with every possible requirement, and in charge of a capable mechanic of the French Navy. Already, as an example of work that can be done in this workshop, it may be mentioned that a small sounding machine, which is used on board one of the Prince's ships, was entirely constructed here.

There is also a special room fitted to contain some 96,000 lantern slides.

The "secretariat" is an important part of the institution as well as a handsome council chamber, in which the "Conseil d'Administration" and the "Comité de Perfectionnement" meet. The secretary's room is decorated in a very beautiful and original manner by a young artist, M. Laugier, who has passed several years studying in the museum at Monaco, at the Sorbonne, and at Roscoff. He has thus become thoroughly familiar with the forms and colours of many living marine animals and plants. He has represented on the walls of the "secretariat" a scene below the sea, so that the secretary lives in a

FIG. 3.—Prof. Portier's Physiological Laboratory.

veritable aquarium—wonderful molluscs, crustacea, and strange fish swimming round among rocks and waving sea-weed, and the whole culminating in a

whirlpool in the centre of the ceiling, in which is figured a cuttle-fish with its outstretched arm.

The council chamber is richly but gracefully ornate, though more orthodox. The large lecture theatre is of excellent Florentine architecture, with fine panels by M. Louis Tinayre, who has accompanied the Prince on board the *Princesse Alice* during several voyages, not only in the Mediterranean and tropics, but also in Spitsbergen. One panel represents oceanographical operations on the deck of the *Princesse Alice*, especially the taking on board of a trawl and a trap from the deep sea. Another represents a whale-boat in charge of the Prince, who is fast to a whale. A third represents the selection of the larger material from the trawl on the deck of the ship, while a fourth pictures finer work being carried out below, inside the scientific laboratory.

The inauguration was presided over by the Prince of Monaco himself, and was graced by the presence of the President of the Republic, M. Fallières, and many members of the Government, and by Ambassadors and Ministers of Foreign Powers at Paris. There were also the members of the "Conseil d'Administration" and of the "Comité de Perfectionnement." A guard of honour, formed from the Republican Guard, lined the streets outside the building, and the band of the Republican Guard played the "Marseillaise" and the Monagasque national anthem as the President of the Republic and the Prince of Monaco entered the lecture theatre.

The proceedings were opened by an eloquent address by the Prince of Monaco, who pointed out that the opening of the institute was the crowning of the work he had devoted his life to during the last twenty-five years. He then proceeded to give an account of the aims and objects of the museum and institute, which have already been given in the pages of NATURE. Finally, he gave the reason why he had chosen Paris as the seat of the institute, and it is best to quote the Prince's own words in his fine peroration, which left a deep impression on the audience.

"Si j'ai choisi cette capitale pour y centraliser mon œuvre, c'est que Paris a gagné la reconnaissance du monde intellectuel: les lettres lui doivent un rayonnement incomparable, les arts ont chez lui une de leurs plus généreuses patries, la science lui doit l'affranchissement qui ouvre à la pensée des champs sons bornes. Mais c'est aussi parce que certaines âmes demeurent toujours sous l'influence de l'atmosphère où sont nées leurs premières affections et où leurs vieilles tendresses sont mortes; où des peines ont fortifié leur courage et où les contingences de la vie ont orienté leurs efforts.

"Le musée océanographique de Monaco semble un vaisseau ancré sur la côte avec des richesses extraites de tous les abîmes; je l'ai donné comme une arche d'alliance aux savants de tous les pays.

"L'édifice où nous sommes recueillera la quintessence du travail élaboré par l'océanographique qui planera idéalisée sur ce vaste domaine universitaire, au milieu du flot grandissant de la science. Et je le confie à cette ville de Paris qui m'a enseigné le travail et dont l'esprit et le cœur ont si souvent dirigé l'esprit et le cœur de l'humanité entière."

The Prince was followed by M. Maurice Faure, Ministre de l'Instruction Publique, speaking in the name of the Government, who eloquently thanked the Prince on behalf of France and the University for his gift.

Others who spoke were M. Armand Gautier, president de l'Academie des Sciences, and M. Liard, vice-recteur à l'Academie de Paris, as well as M. Perrier, directeur du Museum d'Histoire naturelle.

Finally, M. Henri Bourée, aide-de-camp to the Prince of Monaco, gave some very excellent photographs and kinematograph views of work on board the *Princesse Alice*. These included some very marvellous colour photographs of living invertebrates that had been gathered during some of the cruises—the most striking of which was a brilliant physalia, glittering with translucent violet in the sun. The kinematograph also showed the movement of the physalia in a glass tank.

WILLIAM S. BRUCE.

THE OBSERVATORY AT MESSINA.

IN connection with seismological investigations, Italy is the possessor of a prestige which we trust will grow. It was the first European country in which the study of earthquakes received special recognition and Government support. It systematised seismometry, and through M. di Rossi published the *Bollettino del Vulcanismo Italiano*, which, I believe, was the first journal ever issued which dealt specially with hypogenic activities. The work commenced in Italy was extended in Japan, and at the present time every civilised country in the world has established earthquake observatories and recognises the scientific and practical importance of what is now a new science. From the knowledge we now possess of earthquake motion new rules and formulæ for the use of builders and engineers have been established. These have been extensively applied, and we see that the new types of structure withstand violent movements, while ordinary types in their vicinity have failed. The new science has already justified its existence by thus minimising the loss of life and property. A side issue of seismometry has led to the localisation of faults on railway lines and to alterations in the balancing of locomotives. The result of the latter has been to reduce the consumption of fuel.

Now we know that in whatever part of the world we live it is possible to record large earthquakes, even if their origins are so far removed as our antipodes. These teleseismic records have increased our knowledge respecting the interior of our planet, thrown light upon the cause of certain cable interruptions, indicated suboceanic regions where depths are changing, and have had a far-reaching importance in many other directions, both scientific and practical. Although we now know that practical seismometry is open to everyone, still there are particular sites which seem more suitable than others for particular investigations.

The popularity of the seismologist would be enhanced if, like the astronomer, he had the power to predict. The latter tells us exactly when we shall see the next eclipse of the moon. We stand outside our door at the appointed time; the eclipse takes place, and we are again reminded of the accuracy of astronomical calculations. Whether the eclipse did or did not occur at the minute specified, so far as the general public are concerned, might not matter very much, but it would matter if the eclipse really meant, as it was supposed to mean in the Middle Ages, a portent of a great disaster. What the public imagine they would like to know about an earthquake is the time at which it might occur. If this could be stated, and at the same time something about the character of the expected disturbance in earthquake districts, seismology would be liberally supported. Astronomers have received the support of nations since the days of astrology, while seismology is in its childhood seeking for more extended recognition, and it is only as this is afforded that the public should look for replies to their difficult inquiries.

Through the Straits of Messina there is a fault or line of faults in the earth's crust, and from time to time, as in 1783, and in 1908, along these, sudden yieldings have taken place. It has been suggested by many seismologists that before such reliefs of strain take place a measurable amount of rock-bending may

be produced; rock-yielding or distortion of this character seems to have been measured in California before the earthquake of 1906, which ruined San Francisco and other towns.

With properly equipped observatories on two sides of the Straits of Messina, the existence or non-existence of such brady-seismical movements might be demonstrated and limits be recognised which preceded a crash. Kövislegethy has suggested other lines dependent upon the hysteresis of rock masses, along which we might conduct investigation which

The Messina Observatory before and after the Earthquake of December 28, 1908.

may possibly lead to the prediction of disaster. The dividing line between Calabria and Sicily is a theatre of hypogenic activity, and is a place above all others in Europe to be watched and studied carefully. As a site on which to make investigations respecting certain changes which are taking place beneath our feet it is of importance not only to Italy but to the world. We see from a paper we have recently received that the observatory at Messina in 1908 suffered severely, the disaster being chiefly due to the fall of a tower. The extent of this damage is shown in the accompanying figures. If it is only on account of the unique position of this observatory I feel certain that it is the wish of all seismologists to see it restored and re-equipped to extend its useful work.

J. MILNE.

SYNCHRONISATION OF CLOCKS.

DURING the past two years a committee consisting of the following members of the British Science Guild, Sir Hugh Bell, Bart., Hon. Sir John Cockburn, K.C.M.G. (chairman). Sir Norman Lockyer, K.C.B., F.R.S., Major O'Meara, R.E., C.M.G. (representing H.M. Postmaster-General), Sir Alexander Pedler, F.R.S., Dr. F. Mollwo Perkin, Prof. J. Perry, F.R.S., Sir William Ramsay, K.C.B., F.R.S., and Mr. St. John Winne, has been engaged upon the consideration of a problem which has often been referred to in the Press, both lay and technical; that is, the question as to how best may be achieved a systematic observance of absolute Greenwich mean time.

The problem is not altogether one affording opportunities for easy solution, for, as stated in the recently published second annual report of the committee, it is apparently beyond the power of human ingenuity to produce two clocks which will go together for one week. Nor is the problem a new one. In past years there have been many endeavours to utilise the services of electricity for the correction of clocks, so that a number of such may be uniform in their indications. Some time about 1840 Alexander Bain devised an electrically-driven pendulum, the principle of which was adopted by Mr. R. L. Jones, of Chester, to cause the pendulums of a group of clocks to beat in sympathy with a regulator, a system of synchronisation which met with some degree of success, but which was very limited in scope. Since that date the problem has been investigated by many with varying degrees of success.

Greenwich mean time has been for many years, and is yet, the standard time for Great Britain and Ireland, and the facilities afforded by the network of wires under the control of the Post Office authorities have been made use of for the distribution of standard time to those to whom the possession of means for ascertaining at any moment exact Greenwich mean time is a *sine qua non*. The distribution over the wires has hitherto resolved itself into the transmission from Greenwich Observatory—where the standard mean time solar clock is corrected daily about 9 a.m. to accord with the results of the preceding nocturnal stellar observations—of an electrical signal to the Central Telegraph Office in London, whence it is radiated over the telegraph wires to offices in distant towns, and thence over direct circuits to the subscribers who require the intelligence,

the main wires being temporarily connected to the subscribers' circuits by a switch. The Greenwich signal is transmitted to the Central Telegraph Office every hour, and it is therefore available for the use of such persons in London as require it, some few of whom exist.

For the temporary connection of the wires converging on London, which are normally associated with telegraph apparatus, to the Greenwich wire, a unique automatic switching device, called the *Chronopher*, is in use, a portion of which has existed since the early days of the telegraph companies. The apparatus consists of a multiple switch the movements of which are governed by a clock which, by means of certain electrical contacts, is arranged to operate the switch at the proper time. The clock itself is automatically corrected or synchronised by the Greenwich signal, and this clock, which seems to be cœval with the *Chronopher*, in common with certain others of a similar type, is probably one of the earliest successful endeavours to achieve *automatic* synchronisation, by a system which seems to have been introduced by Mr. C. V. Walker, of the Electric Telegraph Company. About 1876 Ritchie, of Edinburgh, introduced an improvement on a synchronising system (as distinguished from a sympathetic system), invented by Bain in 1842, and later appears to have improved on Walker's system, and many clocks synchronised on this principle, as well as Walker's, one of which is yet used at Aldershot for military purposes, are believed to be still in use.

There appear to have been one or two other synchronising methods introduced during the past few decades, but with the exception of the Standard Time Company, the operations of which are confined to London, and a system invented by Mr. Lund, none seems to have achieved a large measure of success; in fact, the Greenwich time signal transmitted by the Post Office is, in general, used to drop time ball, fire guns, or to give other visible or audible signals, the correction of clocks being performed by means of human intervention. A noteworthy method for accomplishing the latter is that introduced by Sir George Airy, sometime Astronomer Royal, which is still used by the Admiralty for correcting the standard clocks at their various dockyards. Each clock, in addition to its ordinary compensated seconds-beating pendulum, is provided with an auxiliary free pendulum, arranged to swing behind the clock pendulum. Normally the latter is latched to one side on a trigger which, at the proper time, is released by the Greenwich signal. When both pendulums are swinging, observations are made to ascertain the phase relationship, and a current of electricity is passed through a fixed electromagnet in such direction as to attract or repel the poles of a permanent magnet attached to the clock pendulum, thereby accelerating or retarding the latter until both pendulums are swinging in synchronism.

The British Science Guild Committee, however, mentions that the correction of clocks by hand is quite out of date and untrustworthy, and is unanimously of opinion that some form of direct physical control of public clocks by electrical synchronisation signals from a central time authority is essential. It seems strange that in a city like London, the largest in the world, and the most important commercially, where exact timekeeping would seem to be of the utmost importance, there should be so few clocks really to be relied upon. The committee refers to "Big Ben," which automatically reports its timekeeping performance to Greenwich Observatory, and the large clock in the portico of the old Post Office in St. Martin's-le-Grand, which is already electrically synchronised, as being probably the two large public clocks in London which can best be relied upon to indicate Greenwich time.

The committee has approached the London County Council, the City Corporation, H.M. Office of Works, the Local Government Board, the Post Office, and the various railway companies, but the response to its inquiries seems to be very discouraging. It appears that the question is treated rather apathetically by all save the Post Office authorities, who alone appear to realise the immense importance of the matter, and who have, within recent years, adopted a simple system applicable for the correction of large and small clocks, as well as public turret clocks, and who are extending the system as circumstances permit. It is stated that the cost of synchronising apparatus is small for any size or type of clock, so that it is possible that one of the main objections to the use of the Greenwich time signal, as at present transmitted, is the amount of the subscription to the Post Office which it involves. It is to be hoped therefore that, if the synchronisation of clocks is to be effected to any considerable extent, the authorities will see their way to provide a synchronising signal at a rate which will not appear to be prohibitive to those who have public clocks under their control.

It is clear from other reports which have appeared from time to time in the Press that municipal authorities and the public are not quite so apathetic as it might appear at first sight, for recently, public clocks have been installed by the local authorities at Aberdeen and Sheffield, and are about to be erected at Liverpool and at Taunton, which are, or will be, all electrically synchronised to Greenwich time. The fact that most of the makers of electric clocks, too, arrange for their master or controlling clocks to be synchronised as required, seems to indicate that they appreciate the feeling that there is some public demand in this direction.

The committee makes a comparison between the practice in this country and the practice abroad, where the importance of correct time seems to be more fully appreciated than here; but, no doubt, although progress in the matter has been somewhat slow in the past, given a reasonably cheap synchronising service, London and the rest of the country will ere long awake to the fact that, as the committee expresses it, a meretricious clock is equally as dangerous as a false yard measure, and then the observance of absolute time, once fairly started in operation, will be a recognised factor in our daily existence.

JULIUS WILHELM BRÜHL.

IT is with much regret that we have to record the death at Heidelberg, on February 5, of Prof. Brühl, the distinguished chemist. He was of Jewish parentage, and was born at Warsaw in February, 1850, and studied from 1868 to 1873 at Zurich and Berlin. In 1873, on completion of his studentship, he became assistant to Prof. Landolt at Aachen, and in 1879 was appointed professor in the University of Lemberg, which chair he resigned in 1884 on account of ill-health brought on by the unsuitability of the climate. After some sojourn at Freiburg (in Breisgau) he was induced by Bunsen to transfer his services to Heidelberg, where, in 1887, he became honorary professor in the high school, and took over the private laboratory of Prof. Bernthsen, who had then entered the service of the Badische Anilin und Soda-Fabrik at Ludwigshafen. In 1889 he commenced lecturing as Bunsen's representative, and was given full title as honorary professor in 1908. Brühl's contributions to science will be appraised in due course: they are

numerous and important and cover a wide range of subjects, chiefly on the border-land of physics and chemistry. His main work, and that with which his name will be always associated, is unquestionably his exhaustive and protracted series of researches on the relationship between the refractivity and the chemical constitution of organic compounds. Following the pioneering work of Gladstone and Dale in this country, Brühl made this subject for many years essentially his own, and he has always been regarded as the leader and chief authority in this branch of physical chemistry. It will be remembered that he was the first to bring optical evidence to bear upon the question of the constitution of the benzene "ring."

Brühl first made his mark in 1880 in that department of physical chemistry in which he laboured with such conspicuous success throughout the latter part of his life. His predecessors in this field had prepared the way by showing that some relationship existed between refractivity and chemical composition, but real progress only began to be made when, by his researches, he showed that the mode of linkage of the atoms, *i.e.* the chemical constitution, was all important in determining this physical property of the chemical molecule. Following up the fruitful line of work thus opened out, he showed further, that not only could the degree of unsaturation of an organic compound be determined by the refractivity method, but that the apparent anomalies between observed and calculated results were referable to the relative positions of the unsaturated groups, and so he invested the method with increased powers as a means of attacking the all-important problem of chemical constitution. Not the least important application of his method, and one which he himself developed towards the end of his career, is the determination by the optical method of the constitution of tautomeric compounds in solution—a problem which eludes ordinary chemical methods. It was this and other developments of his labours which brought him into contact with the researches of the late Sir William Perkin, with whom he was in constant communication and who had the greatest admiration for his work. Perkin was, in fact, attacking this and analogous problems by his method of magnetic rotation, and the influence of the two pioneers upon each other's results is acknowledged in their scientific publications.

A few years ago Brühl underwent a serious operation which crippled his activity and from the effects of which he never completely recovered. By his death science suffers a heavy loss, and this country is deprived of a warm friend, for the Heidelberg professor's Anglophile sentiments are well known. He was a familiar figure here, and highly esteemed by all who had the privilege of his friendship. His knowledge of our language, and of English literature generally, was both wide and deep, and his chief recreation was the reading of the works of English poets and novelists. Many letters by Brühl addressed to the present writer are distinctly high-class literary productions, which would put to shame many of our university graduates. It will be remembered that he was responsible for the German edition of the organic portion of Roscoe and Schorlemmer's treatise. He gave a Friday evening discourse on his own subject at the Royal Institution in May, 1905. He was an honorary member of that Institution, and the University of Cambridge bestowed upon him the honorary degree of Sc.D. during one of his visits to this country. The life-work of Brühl furnishes another illustration of the principle, so generally ignored here, that practical applications follow the development of pure science pursued for its own sake. Out of a series of researches prompted by no immediate practical requirements, but carried out solely with the object of ascertaining how far a particular physical property could be made available for the solution of some of the most abstract of chemical problems, there has arisen a method of the greatest practical utility to manufacturers for the determination of the purity or the value of many products used in chemical industry. Thanks to Brühl the "refractometer" has become a recognised laboratory instrument for technical as well as for scientific purposes.

R. M.

NOTES.

The second reading of the Government Bill for the adoption of Greenwich time as the official time in France was adopted by the French Senate on February 10. In the discussion of an amendment to the measure, reference was made to the Daylight Saving Bill, and it was suggested that the question of introducing Greenwich time into France ought to be deferred until it was known whether our House of Commons would adopt the seasonal change of time-standard proposed in that Bill. The amendment was, however, rejected by 213 votes to 73, and the Bill passed into law, to take effect after the President's signature. France will thus be brought into the international or zone system of time-reckoning, and its official time will differ from other standard times in the system by a definite number of hours. The time of the Paris meridian will, however, be retained for naval purposes.

By the instructions of the London County Council, a blue tablet of encaustic ware has been affixed to No. 32 Soho Square, W., at one time the residence of Sir Joseph Banks, who was elected president of the Royal Society in 1778, and held that office for forty-one years.

The Helmholtz medal of the Berlin Academy of Sciences has, says the *Revue scientifique*, been awarded to Prof. van 't Hoff.

The annual conversazione of the Institution of Civil Engineers will be held on Thursday, June 29, in the Royal Albert Hall.

The next meeting of the Institute of Metals will be the second May lecture, which is to be delivered in London on Friday, May 12, by Dr. G. T. Beilby, F.R.S., on "The Hard and Soft States in Metals." The autumn meeting of the institute will be held this year at Newcastle-on-Tyne on Wednesday and Thursday, September 20 and 21.

Dr. C. R. Beazley, professor of history, University of Birmingham, has been elected a corresponding fellow of the Academy of Sciences of Lisbon, in recognition of his work on mediæval history, and especially on the explorations of the Portuguese.

The gold medal of the Institution of Mining and Metallurgy has been awarded to Sir Julius Wernher, in recognition of his great personal services in the advancement of technological education and in the promotion of the highest interests of the mining and metallurgical professions.

The *British Medical Journal* states that, in response to the request of the Chinese Government for an international commission to proceed to China at an early date to investigate the present outbreak of plague in Manchuria, and to devise means for the prevention of its further spread, the British Government has instructed Dr. Reginald Farrar, one of the medical inspectors of the Local Government Board, to proceed to China at an early date.

SIX Hunterian lectures on "The Fossil Remains of Man and their bearing on the Origin of Modern British Types" are to be delivered in the theatre of the Royal College of Surgeons, Lincoln's Inn Fields, by Prof. Arthur Keith, at 5 p.m. on Mondays, Wednesdays, and Fridays in the fortnight beginning on February 20. The lectures are designed to serve as an introduction to the study of the anthropological collection in the museum of the college.

THE Lannelongue prize, founded last year by Prof. Lannelongue, of Paris, has been presented to Sir Victor Horsley, F.R.S. The prize is a gold medal and the sum of 200*l*., and it is awarded to the person who had contributed most to the progress of surgery in the ten years before the date of the award. It is open to surgeons of all nations, and is to be awarded every five years during the annual meeting of the Société de Chirurgie.

AT the anniversary meeting of the Malacological Society of London on Friday, February 10, held (by permission) at the Linnean Society's rooms, the following officers and council were elected for the ensuing year:—*President*, Mr. R. Bullen Newton; *vice-presidents*, Rev. R. Ashington Bullen, Mr. G. C. Crick, Prof. H. M. Gwatkin, Mr. B. B. Woodward; *treasurer*, Mr. J. H. Ponsonby; *secretary*, Mr. G. K. Gude; *editor*, Mr. E. A. Smith; *other members of the council*, Mr. S. Pace, Mr. H. B. Preston, Dr. W. G. Ridewood, Mr. H. O. N. Shaw, Mr. E. R. Sykes, and Mr. J. R. le B. Tomlin. The president delivered an address entitled "A Sketch of the Chief Geological Zones and their Mollusca."

THE current number of the *Revue scientifique* announces the election of the officers for the present year of several French scientific societies. In the case of the Physical Society, Prof. L. Poincaré is the president, M. B. Baillaud vice-president, M. H. Abraham general secretary, and Prof. Jean Becquerel secretary. Prof. Béhal has been elected president of the Chemical Society. M. Léon Teisserenc de Bort becomes president of the Meteorological Society, MM. Lemoine and Maillet vice-presidents, M. Goutereau general secretary, and M. Besson secretary.

THE *Kainan Maru*, with the members of the Japanese Antarctic Expedition on board, left Wellington, New Zealand, on February 11 for the Antarctic. It is stated that the only chart of the far south possessed by the expedition is a reduced copy of Sir Ernest Shackleton's map, and that the only means of transport on land consist of very light sledges and twelve dogs. A Press message from Hamburg states that the German South Polar Expedition will start from there on May 2. The expenses of the expedition, estimated at 68,000*l*., have been partially guaranteed by Hamburg charterers.

AT the anniversary meeting of the Royal Astronomical Society on February 10, the following officers and council were elected:—*President*, Prof. F. W. Dyson, F.R.S.; *vice-presidents*, Sir W. de W. Abney, K.C.B., F.R.S., Mr. E. B. Knobel, Dr. W. H. Maw, Prof. H. H. Turner, F.R.S.; *treasurer*, Major E. H. Hills, C.M.G.; *secretaries*, Mr. A. R. Hinks, Mr. S. A. Saunder; *foreign secretary*, Sir David Gill, K.C.B., F.R.S.; *council*, Sir W. H. M. Christie, K.C.B., F.R.S., Dr. P. H. Cowell, F.R.S., Dr. A. C. D. Crommelin, Mr. A. S. Eddington, Prof. A. Fowler, F.R.S., Dr. J. W. L. Glaisher, F.R.S., Prof. E. W. Hobson, F.R.S., Mr. H. P. Hollis, Mr. Thomas Lewis, Prof. H. F. Newall, F.R.S., Rev. T. E. R. Phillips, and Mr. F. J. M. Stratton.

AT a meeting of the Institution of Civil Engineers on January 24, the influence of ocean currents along a coastline on the movement of sand was discussed by Mr. G. H. Halligar in describing the conditions on the coast of New South Wales. A permanent southerly ocean current having a velocity of about 1 to 1½ knots per hour inshore causes a sand movement in the direction of its flow which the heaviest seas or gales only temporarily disturb. Observations showed that even the most violent gales from the south only reverse the current during their continuance, while the more frequent northerly winds increase its velocity. The run-off of the rivers is not sufficient to scour out the river-mouths except in heavy flood, and stress is laid on the necessity for so designing harbour entrances that the velocity of the flood-tide entering it may be less than that of the littoral current, in order that the sand in suspension may be carried past the entrance instead of entering the estuary at each tide.

ON February 8 a portrait of Prof. W. Boyd Dawkins, F.R.S., by Mr. W. Llewellyn, was presented to the Whitworth Hall of the University of Manchester by a large number of friends and admirers who wished to show their appreciation of his long and distinguished services to the University, the Manchester Museum, and the City of Manchester generally. The portrait was unveiled by Prof. S. J. Hickson, F.R.S., dean of the faculty of science in the University, and was received on behalf of the University council by Sir Frank Forbes Adam, C.I.E., and the Vice-Chancellor, Sir Alfred Hopkinson. In unveiling the portrait, Prof. Hickson directed attention to the fact that largely through Prof. Dawkins's energy and enthusiasm the present museum has been transformed from the condition of an unclassified local collection of curiosities to be an important reference museum, meeting the wants of students and teachers, the general intellectual public, as well as those workers in science who have to rely on trustworthy material for reference. He also reviewed Prof. Dawkins's contribution to the early history of man, and the vertebrate palæontology of the Tertiary and post-Tertiary ages, as well as his activity in the problems of applied geology. Although Prof. Dawkins has now retired from the chair of geology, he still shares the work of the University as an honorary professor and as a museum lecturer and member of the committee, and thus his retirement from university work is more formal than real.

"THE Academic Aspect of the Science of National Eugenics" (Eugenics Laboratory, Lecture Series, vii. London: Dulau and Co., Ltd., 1911) is the title of a lecture delivered to undergraduates by Prof. Karl Pearson. Its main purport is to emphasise the need for the study of social questions in the same manner that scientific questions are studied. To quote the words of the lecturer:—"You cannot settle such essential problems of society as alcoholism, tuberculosis, mental defectiveness, or the changing status of women, by oratory in the market-place. I claim that these things must be studied in university laboratories, where Oxford shall check the results of Cambridge, and London correct both of them, if need be."

A LIST of publications of the Bureau of American Ethnology, with index to authors and titles, has been published by the Smithsonian Institution at Washington. These publications consist of contributions to North American ethnology, annual reports, bulletins, introductions, and miscellaneous publications. The issue of annual reports began in 1880, and the present maximum edition of an annual report is 9850 copies. With the exception of a few copies of the publications of the Bureau disposed of by the U.S. Superintendent of Documents, the editions are distributed free of charge.

In *Man* for January, Mr. H. S. Cowper describes the exploration of a flint implement factory on a site at Hilwan, Lower Egypt, previously examined by Mr. A. J. Jukes Brown, who contributed papers on the subject to the Journals of the Cambridge Antiquarian Society and the Anthropological Institute in 1877. He discusses the theories that this type of implement may have been used for arming the edges of serrated weapons or for fishing, and, deciding in favour of the latter supposition, suggests that the sites where implements of this type are found should be studied in relation to the fishing industry. He asserts that they have no connection with the Neolithic implements found in such large numbers in recent years in various parts of the desert of Lower Egypt.

The habits of the common American mole, *Scalops*, or *Scalopus*, *aquaticus*, are discussed in two papers, respectively by Mr. F. E. Wood and Mr. J. A. West, published in vol. ix., of the Bulletin of the Illinois State Laboratory of Natural History. This mole, which—despite its name—is not aquatic, undoubtedly does much damage to newly sown cornfields by burrowing along the lines of the drills. From such tunnelled rows the seed is often found to have more or less completely disappeared, and farmers charge the mole with being the culprit. The accusation is proved by Mr. West to be true, the stomachs of many of the moles examined by him containing corn in various proportions to the rest of the food. For the greater part of the year, however, these moles feed on worms and insects.

"The Sudden Origin of New Types" is the title of an article communicated by Dr. F. Oswald to the January number of *Science Progress*. After adducing evidence in support of this theory from plants, the author observes that the sudden rise and predominance of mammals in the Tertiary must be due to rapid development of some part of their organisation, and that this part was the mammary glands. These glands, it is suggested, may have been derived from the lateral-line system of amphibians, since both are developed in the Malpighian layer of the skin. Having stated that such a derivation is "within the range of probability," Mr. Oswald proceeds to regard it as a demonstrated fact, and to argue that, "as a necessary corollary to the absence of the lateral line in all reptiles, it is evident that—contrary to the received and general opinion—the mammals must have taken their origin directly from Amphibia, not from anomodont reptiles." Then follows a review of apparent instances of the sudden rise of certain groups (such as graptolites) or certain organs among invertebrates, special stress being laid on a suggested origin of tracheæ from the gills of a hypothetical fresh-water trilobite by the transformation of the latter into lung-books sunk in the body and communicating with the exterior by means of stigmata.

Much interest attaches to the description by Prof. H. F. Osborn, in the January number of the *American Museum Journal*, of a "mummy" of the iguanodont dinosaur from the Kansas Cretaceous, known as *Trachodon annectans*. The specimen includes, not only the greater part of the skeleton, but likewise a large portion of the epidermis, which "is shrunken around the limbs, tightly drawn along the bony surfaces, and contracted like a great curtain below the chest-area." In the opinion of its describer, the reptile, after dying a natural death, lay for a time on a river-bank, without being molested by birds or crocodiles, until it became thoroughly desiccated, after which it was carried down by a flood, and buried in sediment of a character suited to retain a cast of the surface sculpture. The skin was covered with tubercles, varying in size on different parts of the body. The tenuity of the epidermis favours the theory, according to Dr. Osborn, that these reptiles "spent a large part of their time in the water, which theory is strengthened by the fact that the diminutive fore-limb terminates, not in claws or hoofs, but in a broad extension of the skin, reaching between the fingers and forming a kind of paddle. This marginal web, which connects all the fingers with each other, together with the fact that the lower side of the fore-limb is as delicate in its epidermal structure as the upper, tends to support the theory of the swimming rather than the walking or terrestrial function of this fore-paddle." The article is illustrated with pictures, not only of the "mummy," skin, and skeleton, but likewise of the restored animal, the length of which was about 30 and its height between 15 and 16 feet.

According to the report on the Botanic Station Experimental Plots and Agricultural Education, Antigua, 1909–10, there are indications that the cotton industry may regain some of its late importance. Experiments are reported on the flower-bud maggot and the leaf-blister mite; hybridisation work has also been begun. The production of cocoanuts and limes is increasing, and becoming an important industry; onions are also being more and more grown. Experiments are reported on broom corn and other crops likely to be useful. The report on the Botanic Station, St. Kitts-Nevis, shows that the sugar-cane season has been successful; early planted cotton also did well, and planters are learning to control the pests; there also seems the prospect that cacao and rubber may be successfully grown. Experiments are recorded on yams, sweet potatoes, and onions. The Montserrat report shows useful work is being done in connection with cotton selection and the cultivation of limes. Other lines of investigation deal with the improvement of ground nuts and Indian corn by selection, and the determination of the best varieties of certain provision crops.

An investigation into the effect of coloured light on the development of pure cultures of the green alga *Stichococcus bacillaris* is described by Prof. G. A. Nadson in the *Bulletin du Jardin Impérial Botanique*, St. Petersburg (vol. x., part v.). The cultures raised in reddish-yellow light showed weak growth and colour; those in bluish light showed at first rather weaker development, but eventually the filaments assumed a purer green colour than those in white light, and the improvement was maintained through successive generations grown in blue light. The same author, with Mr. S. M. Adamovic, describes the experiment of adding to a culture solution for *Bacillus myocides* a proportion of the products of catabolism taken from a previous culture of the organism. This produced a marked change in the Bacillus, inhibiting its powers of liquefying gelatin and producing spores, and causing it to form special membranes round its cells.

The International Association of Tropical Agriculture and Colonial Development has issued, in pamphlet form, the report on the present position of cotton cultivation, which was presented to the congress in Brussels in 1910 by Dr. Wyndham R. Dunstan, F.R.S. The reports which Dr. Dunstan has brought together, as reporter-general to the congress on cotton cultivation, relate to all those countries in which cotton cultivation is an established and important industry, and also to those in which cotton cultivation is still in an experimental stage. The writers of the reports were requested to pay special attention to the present position and prospects of the industry, any

special difficulties met with, and the nature of the experimental work in progress. Summaries of all these reports are given here, and Dr. Dunstan discusses generally the more important questions involved, and considers the problems of cotton production as a whole. Copies of the publication can be obtained from the Imperial Institute at 1s. each, or 1s. 1½d. post free.

THE Colonial Annual Report, No. 644, deals with survey work accomplished in British Africa, Ceylon, Cyprus, Fiji, Jamaica, Trinidad, and British Honduras during the year ending March 31, 1910. It is essentially a progress report, and the methods of work employed in the different Crown colonies are therefore not described, and no comparison of them is possible. In several areas triangulation, topographical detailed surveying, and cadastral surveying are in hand, and the last-named is often urgently needed for the settlement of native owners and the allotments of Government lands. The long list of directors and inspectors of survey already engaged on this important work, which is presented at the end of the report, would seem to indicate that the study of advanced surveying may be worth the attention of physical and mathematical students.

METEOROLOGICAL material is rapidly accumulating in Africa, and a valuable contribution is published in the *Mitteilungen der deutschen Schutzgebieten* (Heft 5, Band 23). Tables of the rainfall recorded at fifty-one stations in the Cameroons during 1909 are given detailing the total and maximum in twenty-four hours for each month, as well as the distribution of rainy days. On the whole, the rainfall in the north and south of the colony was not markedly greater than in the previous year, but at a group of stations in the central portion, especially in the Cameroon mountains, the rainfall of 1909 was considerably greater. From the eastern coast of Africa we have the whole of the meteorological observations taken at forty-seven stations in 1907 and 1908 throughout German East Africa from the coast so far inland as Lake Tanganyika.

AN interesting question of geological nomenclature is raised by Prof. J. W. Gregory, F.R.S., in an article in the *Geographical Journal* for February. The terms "denudation," "erosion," "corrosion," and "corrasion" are dealt with, and after an examination and discussion of the uses of these terms by various geological writers, Prof. Gregory makes several suggestions. He thinks it would be convenient, with a view particularly to secure uniformity in Europe and America, to use the terms as follows:—denudation for the wearing down of the land by any agency; erosion for the widespread lowering of the land by wind, rain, and weather, and by rivers and glaciers acting laterally; corrosion for the excavation by rivers and glaciers of their beds; corrasion dismiss as a synonym of corrosion; abrasion for the attack of the sea on the land, though when used in this restricted sense it is well to refer to the process as marine abrasion; solution for the action of solvents.

ON February 13 Major P. H. Fawcett, R.A., lectured before the Royal Geographical Society on the exploration which had to be undertaken in Bolivia before the delimitation of the new frontier between that country and Peru could be carried out. Situated in the extreme north-west of Bolivia, and watered by the Madre de Dios and its tributaries, this plain at the foot of the eastern slopes of the Andes is largely covered by dense forest, and the natives have always been intensely hostile to all parties who have attempted the exploration of this region. The Heath river, previously hardly known, was ascended in canoes, and by gaining the friendship of the natives much assistance was gained. These Guarayos use the milky juice of the "manuna" or "soliman" tree, which is perhaps to be identified with *Hura crepitans*, to capture fish in the lagoons of the forest; it is poured into the water, and every fish coming in contact with it is rendered incapable of movement, though still alive, and in no way impaired as food. Exploration being the object of the expedition, little time could be given to scientific observation, and the weather rendered all astronomical observations for the determination of position impossible. Gold is stated to occur in many parts of the foothills, and copper, antimony, galena, and silver to exist abundantly in a region which is still largely inaccessible.

MR. N. A. KOROSTELEF has collected meteorological observations recorded by various expeditions to Novaia Zemlia, among which those from Malyia Karmakuly extend over sixteen years (Bulletin of the Imperial Academy of Sciences of St. Petersburg, No. 11, 1910). The climate is exceedingly cold and damp, the sky is generally overcast, and exceedingly strong winds are frequent, accompanied by only slight precipitation. The variableness of the weather and of the monthly means of the meteorological readings is very marked. The temperature of March was 19·4° F. in 1907 and −18° F. in 1902. Again, the mean for the winter half of the year (November–April) was 18° F. in 1906–7 and −4° in 1901–2. Cyclones following one another, with occasionally more permanent anticyclones, account for the variableness of the climate. The highest temperatures during the whole period of observation occurred in all the months of the year, that is, a thaw is possible in any month. On the other hand, there was no month without frost; once the thermometer fell in July to 14° F.; 1898 was remarkable for the range of pressure, when the barometer in the short interval from February 8 to March 16 passed from the absolute minimum of the whole period of observation, 28·31 inches, to the absolute maximum, 31·22 inches. There is great humidity in the air in all months, the average being 84 per cent., or 5 per cent. higher than in St. Petersburg. The cloudiness is, on an average, three-fourths, declining to nought in winter and rising so much the higher in summer. The number of days in the year with precipitation was 181; in October the average number was twenty, and in one year there was in March only one day without precipitation. The prevailing winds are south-east and east; only in June do they blow chiefly from the north and north-west. The winds are very high, and the greatest velocity recorded was 131 feet a second. Not infrequently, however, the anemometer was unable to withstand the force of the wind.

A RECENT contribution of Mr. Alfred W. G. Wilson to *Economic Geology* (vol. v., No. 7) gives a descriptive account of the organisation and work of the Department of Mines of Canada. The department dates from 1907, while the Geological Survey of Canada, the forerunner of the present department, was first constituted in 1842. The paper provides interesting particulars as to the development and growth of the work of the department. In past years the funds voted by Parliament for the service of what is now the Department of Mines have usually been little more than 20,000*l.* It is only within the last few years that there has been any notable increase; for 1909–10 the total amount available was 101,000*l.*, being slightly more than one half of 1 per cent. of the annual value of the industry for the same year. For the fiscal year 1910–11 the total vote at the service of the department for all purposes is about 124,000*l.*, which includes

a special grant for the investigation of processes for producing zinc. In this connection, attention may be directed to an advance chapter of the annual report on the mineral production of Canada during 1909, which has been received from the department, dealing with structural materials and clay products. The chapter is by Mr. J. McLeish, chief of the division of mineral resources and statistics. The subjects considered are cement, clay products, lime, sand-lime brick, sands and gravels, slate and stone for building. It appears that 1909 was one of record activity in the building trades. The value of cement sales in 1909 showed an increase of 44 per cent. over 1908, clay products 43 per cent., and lime 58·8 per cent. The total value of the increase in production amounted to well over a million pounds sterling.

THE Bryn Mawr College Monographs continue to show the activity of the institution in scientific research. Vol. viii. of the reprint series contains sixteen mathematical and two physical papers. Miss C. A. Scott contributes an elegant note on the construction of certain regular polygons with the help of an auxiliary hyperbola; and among the numerous papers by Mr. J. E. Wright, those on differential invariants may be mentioned as specially interesting. The physical papers (both by ladies) are on the spectra of sulphur dioxide and on the electric spark in a magnetic field.

IN his presidential address to Section A of the South African Association for the Advancement of Science, delivered on November 2, 1910, Prof. J. C. Beattie gives an historical account of the growth of our knowledge of terrestrial magnetism, dealing more especially with the magnetic elements in Africa. Prof. Beattie regards the establishment of one or more fixed magnetic observatories in South Africa as an object of great scientific importance, and in this he undoubtedly has the support of all the leading magneticians of Europe. An appendix deals with terrestrial lines of declination, dip, and horizontal intensity for South Africa, based on the recent survey by Profs. Beattie and Morrison, and contains a chart for each of the three elements.

THE December (1910) number of *Terrestrial Magnetism and Atmospheric Electricity* contains a report of the Berlin meeting of the Commission on Terrestrial Magnetism and Atmospheric Electricity, and a useful reprint of the whole of the resolutions passed by the commission since the Munich meeting in 1891. Many of these refer to the steps to be taken to facilitate the comparison of the results obtained at different observatories. For this purpose, it is desired that the curves of variation of declination be reproduced to the scale of 1 minute of arc to 1 millimetre, those of horizontal and vertical intensities to the scale of 0·00005 C.G.S. unit to 1 millimetre, and that for disturbances the time scale be 1 hour to 15 millimetres. The importance of regular and frequent comparisons of the instruments used at the various observatories is insisted on. So far, nothing appears to have been done to carry out the suggestion of the commission that magnetic observatories be established along the magnetic meridian passing through the centre of Africa.

SEPARATE copies have been received of two communications made by Dr. F. Jentzsch, of Wetzlar, to the meeting of the German Naturforscher und Arzte at Königsberg in September last, which have appeared in the *Verhandlungen der Deutschen Physikalischen Gesellschaft.* They deal with appliances designed by the author for improving the ultramicroscope. It will be remembered that in the ultramicroscope as used hitherto the light has impinged on one side only of the object. Dr. Jentzsch's concentric condenser and ultracondenser receive the light along the axis of the microscope. It is reflected by a surface underneath the object, and, after further reflection, crosses the axis at right angles at the point at which the object is placed. An intense beam of light is thus produced, and the arrangement has the advantage that it can be fitted to an ordinary microscope.

ACCORDING to a circular issued by the Bureau of Standards at Washington in December, 1910, the Bureau on January 1 adopted the value 1·0183 international volts for the electromotive force of the Weston normal cell at 20° C. This is equivalent to an increase of 0·08 per cent. in the value of the international volt as used by the Bureau. The above value has been arrived at by an international investigation carried out at the Bureau of Standards by representatives of the Bureau, the National Physical Laboratory, the Reichsanstalt, and the Laboratoire Central, and is to be adopted by all these institutions so soon as the various Governments pass the necessary legislation (see p. 508). The international ohm, our readers will remember, is the resistance of a mercury column at 0° C., 106·3 centimetres long, of uniform cross-section, and of mass 14·4521 grams, and the international ampere deposits 0·001118 gram of silver per second.

IN a paper read at the February evening meeting of the Pharmaceutical Society, Dr. W. H. Martindale suggested that rounded-off atomic weights should be adopted in the new "Pharmacopœia." The atomic weights of elements employed in the pharmacopœias of different nations show considerable variation in magnitude, especially with regard to the first, second, and third place of decimals. The figures for such important elements as arsenic, bismuth, bromine, chlorine, iodine, lithium, silver, and sodium vary particularly, and the variations are not accounted for by the fact that the oxygen standard is adopted by some and the hydrogen standard by others. Dr. Martindale's opinion is that, with the exception of the weights for chlorine, copper, and strontium, it might be better to do away with the decimal proportions altogether, and that a rounded-off series of figures like those in the French "Pharmacopœia" would be sufficiently accurate for pharmaceutical purposes. If rounded-off international standards could be arranged, so much the better.

THE Journal of the Chemical Society for January contains the reply of Prof. Komppa, of Helsingfors, to the criticisms of Messrs. Leblanc and J. F. Thorpe on his synthesis of camphoric acid. The critical point in the synthesis depends upon the point of attachment of the last methyl-group introduced into the molecule, which Komppa regards as attached to carbon (as in camphoric acid), whilst Leblanc and Thorpe have urged that its ready removal by alkalies proves it to be attached to oxygen. The original proof that the methyl-group was attached to carbon was based very largely on the fact that camphoric acid was actually prepared from the methylated compound, but it is now shown, further, (1) that the ester contains the group —CO—CO—, because it forms a colouring matter with *o*-phenylene diamine, resembling in this respect the whole series of ortho-quinones, but contrasting sharply with an isomeric ester in which the grouping is changed in the manner suggested by Leblanc and Thorpe to —CO—C(OCH_3)=, and (2) that the Zeisel method of analysis indicates the presence of only two —OCH_3 groups in the ester, although the isomeric ester actually gives the three —OCH_3 groups postulated by Leblanc and Thorpe. So much interest has attached to this synthesis, as settling

beyond all question the structural formula of camphor, that the confirmation now given of the validity of the synthesis is of considerable value and importance.

An article on petrol-engine ratings appears in *Engineering* for February 10. It has never been altogether clear why so much ingenuity has been expended in the invention of formulæ which will give the horse-power of a petrol engine in terms of its physical dimensions, especially as most builders of such engines are quite prepared to state the actual brake-horse-power which has been given by any of their engines. In 1906 the Royal Automobile Club settled on the well-known formula $B.H.P. = 0{\cdot}4D^2N$. This formula is founded on an assumed mean effective pressure of 67·2 lb. per square inch and a piston speed of 1000 feet per minute. A report was presented at the meeting of the Incorporated Institution of Automobile Engineers on February 8, drawn up by the horse-power-formula committee. A new formula is given which avoids the objections raised to that given above, viz. the assumption of values for both the mean pressure and the piston speed, and the form being such that no correction can be applied for the increase of mean pressure which takes place with increase in the diameter of the cylinders, or for the increase in piston speed which occurs with an increased stroke-bore ratio. The committee's formula is based on the results of tests on 144 actual engines, and is as follows:—

$$B.H.P. = 0{\cdot}45(d+s)(d-1{\cdot}18)N,$$

where d is the bore of the cylinder in inches, s the stroke of the piston in inches, and N is the number of cylinders.

We are informed that, owing to an alteration in the publications, papers read before the Physical Society of London in future will appear, in general, only in the Proceedings of the society, and not in the *Philosophical Magazine*. The Proceedings and other publications are now obtainable by the public from the publishers to the society, *The Electrician* Printing and Publishing Company, Ltd., 1, 2, and 3 Salisbury Court, Fleet Street, London, E.C.

The eighteenth report of the Leicester Museum and Art Gallery Committee to the Town Council for the year ended March 31, 1910, has been received. The long-projected extension and reconstruction of the museum and art gallery buildings have now been commenced. Important additions were made to the museum during the year; in the department of Coleoptera and economic entomology, a collection of 6000 specimens of 1300 species was presented by Mr. C. B. Headly, and 408 specimens of 356 species, chiefly from Leicestershire, were given by Mr. F. Bouskell.

OUR ASTRONOMICAL COLUMN.

Nova Lacertæ.—Several further notes on Nova Lacertæ appear in the *Astronomische Nachrichten*. In No. 4470 Prof. Pickering gives particulars concerning the earlier history of the star, according to the Harvard collection of photographs, and states that spectrum photographs by Mr. E. S. King showed eleven bright lines. Prof. Nijland gives the results of magnitude observations at Utrecht showing a gradual decrease in the nova's brightness from 7·40 on January 1 and 2 to 8·30 on January 16; the colour was fairly constant at 3·7, and is found to be similar to that of the long-period variables R Arietis, T Cassiopeiæ, and S Ursæ Maj. at their maxima. Photographic magnitude observations at Munich, reported by Dr. Kühl, agree with the above in showing a somewhat similar decrease over the same period.

In No. 4471 Dr. Max Wolf gives the measures of the nova's position on plates taken on January 17 and in 1904, and raises the question whether the slight difference of 0·10s. in R.A. may be ascribed to proper motion.

Mr. P. M. Ryves has communicated to us his observations of the nova's magnitude, made at Zaragoza, Spain, between January 5 and February 5. The observations were made with a 3-inch telescope, Harvard and D.M. magnitudes being taken for the comparison stars, and show a steady decrease from 7·2 to 8·6 in the observed magnitudes.

A further note concerning the spectrum of the nova, as photographed at the Meudon Observatory, is contributed by M. Idrac to the *Comptes rendus* for February 6. Three fine nights, January 28–31, permitted him to secure photographs with from one to three hours' exposure on panchromatic plates. The very broad, bright hydrogen lines are seen to be divided into two components, of which the brighter show a "shift" of 7 Angströms towards the red, while the fainter are displaced 16 Angströms towards the violet; a dark line, possibly double, occurs on the violet side of $H\gamma$. In the yellow there are three bright bands, at about λ 587·4 (probably helium, 587·6), λ 575·4, and λ 567·5, while the green shows a band, about 30 Angströms broad, having its centre near λ 500, and a bright line at λ 493·7. The band at λ 465, mentioned in the earlier communication, is shown to be multiple, having maxima at λ 462 and λ 466, with a fainter component at λ 470; the bright lines near λ 437·4 and λ 458·3 are also shown, but appear less marked than previously. Other maxima and minima mark the continuous spectrum, and are probably indicative of lines or bands beyond the separating power of the spectrograph; such maxima are well marked in the neighbourhood of λ 425 and λ 445. The presence of nebula lines in the spectrum is open to question, but the strong band near λ 500 suggests the possible presence of the chief nebula line; its great width, however, prevents any definite solution of the question; in fact, all the wave-lengths given may only be accepted as approximations.

Ephemeris for Faye's Comet.—To No. 4469 of the *Astronomische Nachrichten* Dr. Ebell contributes a daily ephemeris for Faye's comet, based on the elements published in No. 187 of the Lick Observatory Bulletins, and extending to March 27. At present the object is very near to π^2 Orionis, and is calculated to be a little fainter than the thirteenth magnitude; its motion is easterly, with a slight northern trend.

Standard Astrometry.—An important suggestion as to the publication of results obtained in accordance with the scheme of the International Astrographic Conference is made by Mr. W. E. Cooke in No. 4470 of the *Astronomische Nachrichten*. This scheme embodies the observation of a definite list of fundamental stars by observatories equipped to carry out such work with the greatest possible accuracy. Other stars, *étoiles de rèpere*, will be connected with these by careful differential observations through a third set of stars employed as "intermediate standards." Mr. Cooke's suggestion is that while the differential observations should be made with the greatest possible accuracy, the results should be published in such a manner as to show the standards upon which each catalogued position depends.

The value of the suggestion is obvious. Although the international fundamental catalogue will probably be far superior to any now existing, future improvements in the standards are inevitable, and if Mr. Cooke's plan is followed, future observers will be able to reduce the individual published observations to the improved standards.

Mr. Cooke has followed this plan in vol. iv. of the Perth Observatory Meridian Observations, 31° to 33° S. (1900), recently received, and in an appendix he gives blank columns in which the corrections, dependent upon the future improvement of the places given in the "Perth Catalogue of Standard Stars, 1905·0," can readily be inserted.

New Spectroscopic Binaries.—Lick Bulletin No. 182 gives the measures of a number of stars of which the radial velocities have recently been discovered to be variable. The following were discovered on plates secured at Santiago, generally with the two-prism instrument, and are described by Mr. J. H. Moore:—λ Hydri, γ Mensæ, ξ Columbæ, h^1 and h^2 Puppis, δ Antliæ, θ_1 Crucis, ξ^2 and h Centauri, and d Lupi; for h Centauri Mr. Paddock finds a period of about 16·7 days. Observations made during

1904–7 show that ζ Gruis is a binary with a range of velocity from $-8\cdot7$ to $+1\cdot7$ km.

Variations in the radial velocities of the following stars have also been detected from Lick and Santiago observations, and are reported by Prof. Campbell:—16 Aurigæ, o_2 Canis Maj., 12 Comæ Berenices, 4 Ursæ Min., i and 36 Ophiuchi, f Draconis, A Sagittarii, and α Cygni. In the case of i Ophiuchi, a plate taken on April 28, 1910, shows that the line at λ 4481 distinctly double, giving radial velocities of -77 km. and $+9\cdot2$ km. for the two components. Fifteen plates of α Cygni, taken between August, 1896, and December, 1909, show that the variability of the velocity is not great, the range being from 0 to 7·9 km.

OBSERVATIONS OF JUPITER'S GALILEAN SATELLITES.—In No. 5 of the Transvaal Observatory Circulars, Mr. Innes gives an account of the observations of Jupiter's satellites made at the observatory during December, 1909, to August, 1910. The observations were made with the 9-inch refractor, and, in addition to the times of occultations and transits, remarks are added as to the appearance of the satellite, the phenomena of its disappearance or reappearance, and the appearance of various belts on the planet itself. Mr. Innes records that on February 16, 1910, the final occultation of J III was long drawn out; whereas five-sixths of the satellite was occulted in $6\frac{1}{2}$ minutes, the remaining one-sixth took another 6m. 10s. When half the satellite was occulted, the remaining half had the appearance of a close double star alongside Jupiter's edge. Satellites I and III were occasionally remarked to be oval rather than round, and several spots and markings were seen on their discs. An unpredicted partial transit of IV across the N. pole of Jupiter occurred on August 14, 1910.

A CONFIRMATION OF THE DISINTEGRATION THEORY.[1]

IT is probable that the transition from radium through the emanation to radium D involves the loss of four α particles, that is, four atoms of helium. The atomic weight of radium may now be taken to be 226·4, and if, on changing into niton, one α particle is lost, it is to be expected that the atomic weight of niton should be 222·4, for $226\cdot4-4=222\cdot4$. But attempts to estimate the density of niton by determinations of its rate of diffusion have in most cases yielded the value 176 to 180, though Perkins, comparing the diffusion-rate with that of mercury vapour, obtained the value 235; and Debierne, using Bunsen's method of causing the gas to issue through a minute hole, arrived at the value 220. Undoubtedly the emanation belongs to the series of the inactive gases, and to complete the series—helium, 4; neon, 20; argon, 40; krypton, 83; and xenon, 130—there is room for two higher members with atomic weights 178 and 222·4.

It might happen that, in the disintegration of radium to niton, a non-radio-active substance might be produced of atomic weight 44; the change would then be:—radium (226·4) = helium (4) + (say) scandium (44) + niton (178·4).

The only certain method of ascertaining the molecular weight of a gas is the determination of its density; and in this case it is almost certain that the gas is monatomic, and that its molecular and atomic weights are identical. This constant has now been determined by the help of a balance closely resembling one recently described by Steele and Grant in the Proceedings of the Royal Society.

For details of the construction and use of the balance, the original paper must be referred to; suffice it to say here that its sensibility is about two or three millionths of a milligram. The weight is ascertained by the alteration of the pressure in the balance-case, thus altering the buoyancy of a small bulb of silica containing about 20 cubic millimetres of air, the weight of which is 0·027 milligram, or 27,000 millionths of a milligram.

A preliminary experiment, in which 0·0977 cubic millimetre of xenon was weighed, gave its weight as 578 millionths of a milligram instead of the calculated 577; it was thus shown that fairly good results might be expected in determining the density of the emanation.

In a month, the emanation may be taken as having wholly changed into its degradation products, the chief of which is radium D; and an experiment was made in which a minute density-tube was left on the balance for three months before it was opened, evacuated, and reweighed. The loss was helium, and its weight was 27 millionths of a milligram; the calculated weight, on the assumption that the density of niton is $222\cdot4/2=111\cdot2$, and that each volume of the emanation yields three volumes of niton on disintegrating, should have been 38 millionths. This helium, judging from previous experience, had probably penetrated the glass of the density-tube and been retained there. The tube was therefore heated *in vacuo*, and the evolved helium washed out with a cubic centimetre of oxygen; the gases were transferred to a measuring apparatus, and after absorbing the oxygen by charcoal cooled with liquid air, the helium was measured. Calculating the volume to weight, its weight must have been 8 millionths; and the sum of 8 and 27 gives 35, instead of the calculated 38 millionths of a milligram. A further proof is thus given of the conclusion drawn by Ramsay and Soddy from the measurement of the volume of niton, and of the helium into which it changes, that the latter is three times the former.

Five determinations of the density of niton were made; stated as atomic weights, the figures are:—227, 226, 225, 220, and 218; the mean is 223. This number is the one calculated on the assumption that when radium disintegrates, the only immediate products are niton and helium, $226\cdot4=222\cdot4+4$.

In suggesting the name niton for the cumbrous expression "radium emanation," the authors point out that it is advisable to indicate by a similar name the fact that this gas belongs to the argon series; were its radio-active relations to be emphasised, as in the term "radium emanation," it would be necessary to rename radium as a derivative of uranium by some such name as would introduce the word uranium.

The authors regard the work as a further proof, if any were needed, of the beautiful disintegration theory of Rutherford and Soddy.

[1] "The Density of Niton (Radium Emanation) and the Disintegration Theory." By R. Whytlaw Gray and Sir William Ramsay, F.R.S. Abstract of paper read before the Royal Society on January 12.

SAFETY LAMPS AND THE DETECTION OF FIRE-DAMP.

WE have received from the Home Office a leaflet and a card in a convenient form for carrying about in the pocket, upon which are shown, reproduced in colour, the appearances presented by the miner's lamp in the presence of fire-damp. The difficulty of reproducing the appearances presented by a fire-damp "cap" in the safety lamp is very great, but it must be admitted that the illustrations issued by the Home Office are of a very high standard of excellence, whether considered from the artistic or from the technical point of view. Necessarily, these illustrations suffer from various defects: the Home Office does not state what class of lamp was employed or the nature of the oil burnt in it, and it is a well-known fact that these conditions influence greatly the nature and appearance of the cap. It is, for example, very well known that the Wolf lamp, burning benzene, is more sensitive than an ordinary Massant lamp burning, say, colza, or a mixture of colza and mineral oil.

We very much doubt whether one man in ten would be able to see $1\frac{1}{2}$ per cent. of fire-damp, as indicated on the card, the lower limit of visibility with most men being about 2 per cent. It is, of course, well known that men's eyes differ very considerably in the power of seeing these faint caps, and the representations here given are of caps as they appear to a man whose eyesight is well developed by training and well fitted by nature for seeing these delicate phenomena. It is a pity that the Home Office has not directed the attention of miners more strongly upon the card, in the same way as it has done in its leaflet, to the danger attending far smaller proportions of fire-damp than the lamp can detect in the presence of coal-dust.

It is to be feared that the issue of the card without such a caution as we have referred to, will induce among miners the fixed opinion that they are perfectly safe so long as their lamp shows no cap. But it is well recognised that a

far smaller percentage of fire-damp than any lamp will detect may be the source of the gravest danger in the presence of coal-dust, and we hope that, in subsequent issues, the Home Office will see its way to lay the strongest possible stress upon this fact. The average pitman is only too prone to believe that anything which the Home Office does not distinctly declare to be dangerous, must be absolutely safe, and every care should be taken to dispel so fatal a confidence.

FLIES AS CARRIERS OF INFECTION.[1]

THE reports referred to below include the results obtained in the further investigations concerning flies as carriers of infection. These are considered under the following heads:—(1) observations on the ways in which artificially infected flies (*Musca domestica*) carry and distribute pathogenic and other bacteria, by Dr. G. S. Graham-Smith; (2) summary of literature relating to the bionomics of the parasitic fungus of flies (*Empusa muscae*), by Mr. Julius Bernstein; (3) note as to work in hand, but not yet published, and as to proposed further work in reference to flies as carriers of infection, by Dr. S. Monckton Copeman, F.R.S.

Dr. Graham Smith gives the results of an elaborate series of experiments in connection with the *rôle* which house-flies are supposed to play in the dissemination of disease. He has proved conclusively (*a*) that in artificially infected flies non-spore-bearing pathogenic bacteria do not survive on the legs and wings for more than a few hours (five to eighteen); (*b*) that these bacteria (*a*) frequently survived within the crop for several days, and usually for a longer period in the intestine; (*c*) that the fæces and regurgitated fluids ("vomit") often contain the organisms (*a*) in considerable numbers, and that they may remain infective for varying periods; (*d*) that "the only spores (*B. anthracis*) with which experiments were made survived on the legs and wings, in the crop and intestine, and also in the fæces, for many days.

His somewhat premature conclusions regarding naturally infected flies are that cultures of pathogenic organisms may occasionally be obtained from them, but that this does not "afford conclusive evidence that such flies are a frequent source of disease in man by infecting food materials." Several of the photographic illustrations accompanying this memoir are extremely poor and of little scientific value.

Dr. Bernstein's contribution consists of a short *résumé* of the literature relating to the fungus *Empusa muscae* (Cohn).

Dr. Monckton Copeman has elaborated an excellent organisation for the elucidation of the question as to the range of flight of house-flies, and trials will also be made of the respective value of various baits that have been proposed from time to time for attracting and killing flies. The results of these investigations will doubtless prove of great value, and materially assist in the methods of controlling this ubiquitous pest.

REPORTS OF METEOROLOGICAL OBSERVATORIES.

MADRID OBSERVATORY (1902–5).—The meteorological observations for these four years are included in one volume (recently published). The data for each year are divided into three sections:—(1) daily observations and monthly means; (2) monthly and annual summaries, with differences from normal values; (3) daily sunshine observations, with monthly and yearly summaries. This volume completes the series of these valuable observations, which for subsequent years have been published in yearly volumes. The observations call for no special remark, except that they appear to have been very carefully made, and that full information of instruments and methods is supplied. The average amount of sunshine during the four years was 66 per cent. of the possible amount, as compared with twenty-five years' normal of 44 per cent. at Jersey.

Royal Magnetical and Meteorological Observatory, Batavia (1907).—The observations include hourly readings and results, and a list of the earthquakes and tremors registered by Milne's seismograph and Ehlert's horizontal pendulum. The mean temperature of the year was 26·0° C., which is practically normal. The month with highest mean of daily maximum was October, 31·0° C., and that with lowest mean minima August, 22·6° C. The absolute maximum was 34·5°, in October; minimum, 20·4°, in June. The mean magnetic results were:—declination, 0° 52·21′ E.; horizontal intensity, 0·367105 (C.G.S.); dip, 30° 55·17′ S.; vertical force, 0·219877 (C.G.S.). A new series of observations of upper clouds was started in 1907, and the observatory is cooperating with the Zürich astronomical observatory for the observation of sun-spots. A regular service of kite and balloon ascents has also been recently established.

Odessa Observatory (1908).—The meteorological observations for this year have been published by Prof. B. V. Stankevitsch, who has been appointed director in the place of Prof. Klossovsky. In addition to the usual observations for the year, a useful summary of the results for 1870–1908 is given. The mean annual temperature is 50·2°; January 26·6°, July 73·8°; absolute maximum, 96·4° in July, minimum, −18·8° in February. The average number of days of frost is 91. The average annual rainfall is 15·98 inches; the wettest year, 24·62 inches, the dryest, 8·97 inches. The greatest fall in one day was 3·1 inches. An appendix contains an account of magnetic determinations made by the director in the summer of 1908 in the governments of Smolensk and Kaluga.

Mysore, Rainfall Registration (1909).—The tables show monthly, seasonal, and yearly values for stations and districts, also averages extending over many years. The values for 1909, and average annual values, are also exhibited on maps. The rainfall of 1909 was very favourable as compared with that for 1907 and 1908. For the whole province, the year's aggregate was 42·44 inches, being 5·50 inches, or 15 per cent., above the normal. On the whole, the excess was greatest in January, caused by a cyclonic storm crossing the south of the peninsula to the Arabian Sea. The greatest falls in twenty-four hours were 11·10 inches in Shimoga district (July 12) and 13·96 inches in Kadur (June 6).

ASSOCIATION OF TECHNICAL INSTITUTIONS.

THE eighteenth annual conference of the Association of Technical Institutions was held at the Stationers' Hall on February 10 and 11. Sir Henry Hibbert, the president for the forthcoming year, delivered his address in the afternoon of Friday. In the course of the address he pointed out that modern labour conditions render it difficult for a boy to learn every branch of his trade. It is therefore necessary that workshop practice should be supplemented by the technical school. Day training classes must be developed in order that those who are to take the leading positions in great industrial concerns—the master, his sons, managers, and foremen—may be scientifically equipped, but the bulk of the provision of technical education must be made by and through evening classes. He would like to extend the day-school life—no boy to leave school before the age of fourteen, and then to have a part-time system up to seventeen. Students should not be allowed to specialise too early. He would make preparatory classes compulsory before students were allowed to join trade classes. To avoid irregularity of attendance, employers of labour must be got thoroughly in sympathy with the organised efforts of education authorities. Conditions have changed since the time when a man could say he had succeeded without education. The education provided at the secondary schools under the regulations of the Board of Education is not that required by children who are able to remain at school for a limited period prior to entering on industrial pursuits. For these special schools are required. He believed that British employers are not awakening to the necessity of strengthening their producing power by the employment of highly skilled workmen.

[1] Further Reports (No. 3) on Flies as Carriers of Infection. Reports to the Local Government Board on Public Health and Medical Subjects (new series, No. 40). Pp. 48+7 plates. (London: Printed for His Majesty's Stationery Office, 1910.) Price 9*d*.

The first part of the meeting on the Saturday morning was occupied in a severe criticism of the Board of Education. The association has frequently had to complain in previous years of the late issue of the regulations, but this last time the Board issued the regulations only just before the commencement of the session, and at the same time it suddenly insisted upon the substitution of a new and complicated system of registration for the systems which had previously been used by local authorities throughout the country. Strong letters of protest were sent by the council of the association to the Board, and at the meeting on Saturday a discussion upon the subject was opened by Mr. Crowther (Halifax), who pointed out that the multiplication of registers which the Board's regulations required rendered accurate registration almost impossible, and it appeared as though they considered educational efficiency a matter of small moment so long as statistics were obtained. Other speakers followed, all condemning the Board's action, and the meeting unanimously passed a resolution approving of the action of the council and of the request made by the council that the Board should receive a deputation upon the subject.

During a discussion which followed upon the Course System, speakers from different parts of the country showed that, by insisting upon the junior students taking properly organised courses, although at first there was usually some diminution in the number of individual students, this was more than compensated for by the better work and the greater regularity of attendance which always followed. Very striking statistics were furnished by more than one speaker. Mr. Reynolds, of Manchester, said that local education authorities, who bore not only the lion's share of the expense, but the lion's share of the hard work, would not submit to the Board's ukase in these matters. Local effort was the very essence of success in educational administration. He had no sympathy with the idea that a boy or girl who had been irregular in attendance at one class of a particular course should be required to discontinue the whole course. The difficulties and exigencies of life were such that it was often very difficult for boys and girls to maintain a continuous attendance. Educationists must fight for the principle that boys and girls between the ages of fourteen and seventeen should work a limited number of hours a week in order that they may be able to continue the education which up to the age of fourteen had cost the country so much. He was strongly opposed to insisting upon any rigid course system in the case of adult students. At a school of technology there were so many varieties of students that it was impossible to force them into courses. Several other speakers emphasised this point of view, and at the close of the discussion the following resolution was moved by Dr. Clay and carried unanimously:—

"While it is desirable that, as a rule, young students should be required to take systematic courses of study, the enforcement of similar courses in the case of adult students is strongly to be deprecated, and a large discretion should be left in the case of all courses, so that special conditions and local circumstances may receive due consideration."

The members of the association were entertained at luncheon by the Stationers' Company on Friday, February 10. The master acted as host, and proposed the toast of the Association, to which Dr. Glazebrook, the retiring president, replied. Sir Philip Magnus, in proposing the toast of the Board of Education and Local Education Authorities, remarked upon the great development of the Board's work which had occurred during the time in which Sir Robert Morant had been in charge, which he said had increased by some four-fold. Sir Robert Morant, and Mr. Hastings Jay, the chairman of the London County Council Education Committee, replied.

PROGRESS OF THE SMITHSONIAN INSTITUTION.[1]

DURING the past year the institution's activities have been increased to some degree by gifts for the promotion of certain special lines of study, particularly in biological research. Among the important works that might be undertaken, I would especially direct attention to the great advantage to the United States and to the world that would result from the establishment of a national seismological laboratory under the direction of the Smithsonian Institution.

[1] From the report of the Secretary of the Smithsonian Institution, Dr. C. D. Walcott, for the year ending June 30, 1910.

Proposed National Seismological Laboratory.

The immense destruction of life and property by certain large earthquakes emphasises the importance of investigations which may lead to a reduction of the damage of future earthquakes. The science of seismology is in its infancy, and it is not always evident what lines of investigation will yield the most important results, hence the importance of developing larger knowledge of seismology in all directions. As an example: It was not at all realised that the accurate surveys of the Coast and Geodetic Survey in California would demonstrate that the great earthquake there in 1906 was due to forces set up by slow movements of the land which have probably been going on for a hundred years. We have learned that slow movements of the land must precede many large earthquakes, and monuments are now being set up in California to enable us to discover future movements of the land, and thus to anticipate future earthquakes. This, I think, is the most important step so far taken toward the prediction of earthquakes.

Seismological work is too large to be prosecuted successfully by the universities, but requires some central office under Government supervision to encourage theoretical and observational studies and to collect and study information from all available sources. The seismological laboratory would serve as a clearing house for the whole country. It would also be the link to connect seismological work in the United States with the work done in other parts of the world.

The work of the laboratory would thus be:—(1) Collection and study of all information regarding earthquakes in the United States and its possessions. The preparation of maps showing the distribution of earthquakes and their relation to geological structure. (2) The study of special regions which are subject to frequent earthquakes to determine, so far as possible, where future earthquakes are likely to occur. (3) The study of the origins of earthquakes occurring under the neighbouring oceans. (4) An organisation of commissions to study in the field the effects produced by large earthquakes. (5) The study of proper methods of building in regions subject to earthquakes. This will require experiment. (6) The improvement of instruments for recording earthquakes. (7) Other theoretical studies. (8) The dissemination of information regarding earthquakes by bulletins or otherwise.

Smithsonian African Expedition.

In the last report there was given an account of the setting out of the expedition to Africa in charge of Colonel Theodore Roosevelt, and of the results accomplished prior to June 30, 1909. This expedition, which was entirely financed from private sources through contributions by friends of the Smithsonian Institution, landed at Mombasa on April 21, 1909, and arrived at Khartoum on March 14, 1910. The collections made by it reached Washington in excellent condition, and are now deposited in the National Museum. The series of large and small mammals from East Africa is, collectively, probably more valuable than is to be found in any other museum of the world. The series of birds, reptiles, and plants are also of great importance, and the study of the material representing other groups will furnish interesting results. Colonel Roosevelt reports on the work of the expedition as follows:—

"We spent eight months in British East Africa. We collected carefully in various portions of the Athi and Kapiti plains, in the Sotik and around Lake Naivasha. Messrs. Mearns and Loring made a thorough biological survey of Mount Kenia, while the rest of the party skirted its western base, went to and up the Guaso Nyero, and later visited the Uasin Gisbu region and both sides of the Rift Valley. Messrs. Kermit Roosevelt and Tarlton went to the Leikipia Plateau and Lake Hannington, and Dr. Mearns and Kermit Roosevelt made separate trips to the coast region near Mombasa. On December 19 the expedition left East Africa, crossed Uganda, and went down the White Nile. . . .

"On the trip Mr. Heller has prepared 1020 specimens of mammals, the majority of large sizes; Mr. Loring has prepared 3163, and Dr. Mearns 714, a total of 4897 mammals. Of birds, Dr. Mearns has prepared nearly 3100, Mr. Loring 899, and Mr. Heller about 50, a total of about 4000 birds. Of reptiles and batrachians, Messrs. Mearns, Loring, and Heller collected about 2000.

"Of fishes, about 500 were collected. Dr. Mearns collected marine fishes near Mombasa and fresh-water fishes elsewhere in British East Africa, and he and Cuninghame collected fishes in the White Nile. This makes in all of vertebrates: mammals, 4897; birds, about 4000; reptiles and batrachians, about 2000; fishes, about 500; total, 11,397.

"The invertebrates were collected carefully by Dr. Mearns, with some assistance from Messrs. Cuninghame and Kermit Roosevelt. A few marine shells were collected near Mombasa, and land and fresh-water shells throughout the regions visited, as well as crabs, beetles, millipeda, and other invertebrates.

"Several thousand plants were collected throughout the regions visited by Dr. Mearns. . . . Anthropological materials were gathered by Dr. Mearns, with some assistance from others."

Cambrian Geology and Palaeontology.

During the field season of 1909 I continued my investigations in the geology of the Cambrian and pre-Cambrian rocks of the Bow River Valley, Alberta, Canada, and on the west side of the Continental Divide north of the Canadian Pacific Railway in British Columbia.

The measurements of the Cambrian section were carried down to a massive conglomerate which forms the base of the Cambrian system in this portion of the Rocky Mountains. This discovery led to the study of the pre-Cambrian rocks of the Bow River Valley. These were found to form a series of sandstones and shales some 4000 feet in thickness, that appear to have been deposited in fresh-water lakes prior to the incursion of the marine waters in which the great bed of conglomerate and the Cambrian rocks above were deposited.

Study of American Mammals.

Through the generosity of a friend of the institution, Mrs. E. H. Harriman, there has been provided a trust fund yielding an income of 2400*l.* a year, which is placed under the direction of the Smithsonian Institution for the specific purpose of carrying on scientific studies, particularly of American mammals and other animals, the donor specifying Dr. C. Hart Merriam as the investigator to carry on the work during his lifetime.

Biological Survey of the Panama Canal Zone.

It is gratifying to state that it now seems possible that an exhaustive biological survey of the Panama Canal Zone will be undertaken in the winter of 1910–11. Definite plans for this survey have not been decided upon at present, but these are now under consideration, and it is hoped that all the arrangements may be completed and the work put in hand in a few months.

It is particularly important to science that a biological survey of the Canal Zone be made at this time, as it appears, without question, that it would yield important scientific results, both as regards additions to knowledge and to the collections of the United States National Museum and other museums. While the Isthmus is not so well endowed with large forms as the great continental areas, such as Africa, southern Asia, and some other regions, yet its fauna and flora are rich and diversified. The collecting which has been carried on there has been on such a rather limited scale, and chiefly along trade routes, that an extensive and thorough survey would surely produce new scientific information of great value.

A part of the fresh-water streams of the Isthmus of Panama empty into the Atlantic Ocean and others into the Pacific Ocean. It is known that a certain number of animals and plants in the streams on the Atlantic side are different from those of the Pacific side, but as no exact biological survey has ever been undertaken, the extent and magnitude of these differences have yet to be learned. It is also of the utmost scientific importance to determine exactly the geographical distribution of the various organisms inhabiting those waters, as the Isthmus is one of the routes by which the animals and plants of South America have entered North America, and *vice versa*. When the canal is completed, the organisms of the various watersheds will be offered a ready means of mingling together, the natural distinctions now existing will be obliterated, and the data for a true understanding of the fauna and flora placed for ever out of reach.

By the construction of the Gatun dam, a vast fresh-water lake will be created, which will drive away or drown the majority of the animals and plants now inhabiting the locality, and quite possibly exterminate some species before they become known to science.

Antiquity of Man in South America.

In March, 1910, the institution directed Dr. Ales Hrdlička, curator of the division of physical anthropology, United States National Museum, to proceed to South America and Panama Canal Zone for the purpose of making anthropological researches, and particularly to undertake investigation into the question of man's antiquity in Argentina. Dr. Hrdlička was accompanied by Mr. Bailey Willis, of the United States Geological Survey.

The subject of man's antiquity in South America dates from the meagre reports concerning the scattered remains in the Lagoa Santa caves in Brazil, the casual Seguin finds in the province of Santa Fe, Argentina, and the Moreno collection of old Patagonian material in the valley of Rio Negro, and it has assumed a special importance during the last decade through a relatively large number of reports by Argentinian men of science, but particularly by Prof. F. Ameghino, of new finds of the remains of ancient man and of traces of his activities. Some of these more recent finds were so interpreted that, if corroborated, they would have a most important bearing, not merely on man's early presence in the South American continent, but on the evolution and the spread of mankind in general.

Under these conditions, and in view of the fact that some of the reports were not fully satisfactory as to their anatomical or geological details, it was deemed necessary to send down competent men who might subject the whole matter to critical revision.

The researches occupied nearly two months. Every specimen relating to ancient man that could still be found was examined, and every locality of importance where the finds were made was visited and investigated. The evidence gathered, unfortunately, does not sustain a large part of the claims that have been made. The human bones and the archæological specimens which should represent geologically ancient man agree in all important characteristics with the bones and work of the American Indian; and the finds, while often in close relation with early Quaternary or Tertiary deposits, bear, so far as observed, only intrusive relations to these deposits. Furthermore, there are specimens the original sources of which are not so well established that scientific deductions of great consequence can be safely drawn therefrom, even though they present some morphological peculiarities.

The expedition secured numerous geological, palæontological, and anthropological specimens, some of which throw much light on the question of the antiquity of the finds to which they relate. These specimens are being identified and described in the National Museum. Dr. Hrdlička and Mr. Willis will present in due time a detailed report on their investigations.

Following the researches in Argentina, Dr. Hrdlička visited several of the anthropologically important localities on the coast of Peru and made large collections of skeletal material, which will help to settle definitely the racial problems of these regions, and will have an important bearing on the anthropology of the western part of South America.

Astrophysical Observatory.

The work of the Astrophysical Observatory during the year has brought two important results:—

(1) The first result is the establishment of an absolute scale of pyrheliometry within three parts in one thousand as the result of a long series of experiments with various

pyrheliometers. The establishment of this scale through Mr. Abbot's standard pyrheliometer has been supplemented by the distribution abroad and at home of several secondary pyrheliometers constructed through a grant from the Hodgkins Fund. The constancy of the scale of these secondary pyrheliometers has been established, and it is desirable to compare this scale with those in use elsewhere. It is hoped that finally all pyrheliometric observations will be made on the same scale as that used here.

(2) The second result of the year's work is the agreement within 1 per cent. of the "solar-constant" observations obtained by Mr. Abbot at the Smithsonian Mount Whitney station in California at an elevation of 14,500 feet with those obtained simultaneously at the Mount Wilson station in California at an elevation of only 6000 feet. This determination, in combination with the above-mentioned establishment of an absolute scale of pyrheliometry, gives 1·925 calories per square centimetre per minute as a mean value, for the period 1905–9, of the rate at which the earth receives heat from the sun when at its mean distance. Determinations made with various forms of apparatus show no systematic difference in this value of the "solar constant." In 1905 this "constant," according to various authorities, was stated at values ranging between 1·75 and 4 calories.

It is improbable that observations would have been continued since 1902 on "solar-constant" work but for a suspected variability of the radiation sent to us from the sun. The laws governing this variability are of extreme importance for utilitarian purposes apart from their interest to astronomers. While confident of the existence of variations of this value extending over somewhat long periods, and of the probability of short-period variations as shown by the observations obtained on Mount Wilson, yet, in order to establish full confidence in the minds of others of this variability of the sun's heat, there is a very pressing need of observations made simultaneously at some other place where they could be made over a longer period than is possible at Mount Whitney. This new station should be so situated that observations could be continued there while the winter rainy season prevents them at Mount Wilson. A station in Mexico would best fulfil such conditions.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The University of Birmingham has for some years been in considerable financial difficulties, for, in addition to the great outlay incurred in erecting and equipping the new buildings, it has been faced with an annual excess of expenditure above income. On last year's working the loss was about 12,000*l*., and it is estimated that, even with most rigid economy, there will be a deficit of 10,000*l*. on the present year. This fact, combined with the additional circumstances that the University has practically reached the limit of its power to borrow money, has been a cause of grave anxiety to those responsible for the management of the finances. At present the situation is critical, and it is felt that unless further help is forthcoming, not only must further development be out of the question, but even a retrograde movement will be inevitable. Indeed, in the existing state of affairs economy is being exercised to such an extent as to imperil efficiency. The response of the Chancellor of the Exchequer to the recent appeal of English universities brought matters to a crisis, for, as is well known, the allotment of the increase of the Treasury grant is to be determined largely by the extent to which local support is forthcoming. At this juncture a letter was sent by the Chancellor (the Rt. Hon. Joseph Chamberlain) to the Lord Mayor asking for further assistance from the City Council in the form of an addition to the halfpenny rate already granted for the support of the University. The matter was referred to the Education Committee, with the result that the committee recommended the City Council to increase the rate to an amount equivalent to "one penny in the pound for the year 1911–12 . . . and so from year to year until the council shall otherwise direct. Further, that it be a suggestion to the authorities of the University that they should increase the number of maintenance scholarships available for persons who would not otherwise be able to take advantage of university teaching." This recommendation has now been approved by the council, with the exception that the grant is for the one year only. In view of the probability that the "Greater Birmingham" scheme will have come into effect by next year, it was deemed advisable that the matter should then be open to discussion by the enlarged council resulting from that scheme. An interesting feature in the discussion of the question throughout was the evidence of a widespread desire that further facilities, in the nature of scholarships, should be provided for poor students.

CAMBRIDGE.—The special board for biology and geology has nominated Mr. K. R. Lewin, Trinity College, to use the University table at Naples for six months from March 1.

Sir Francis E. Younghusband, K.C.I.E., will deliver a lecture in Cambridge on Thursday, February 23, on "Practical Geography."

The Secretary of State for India in Council has informed the Vice-Chancellor that, as the result of careful consideration of the existing regulations as to the training of probationers for the Indian Forest Service, he has decided to modify them in accordance with the following decisions at which he has arrived:—(1) Any university which possesses a forest school approved by the Secretary of State shall be permitted to train forest probationers. (2) The Secretary of State is prepared to approve for this purpose the forest schools existing at the Universities of Oxford, Cambridge, and Edinburgh. (3) A course of training in practical forestry in Germany or elsewhere, a certain standard of knowledge in an Indian vernacular, and any other special qualifications that the Secretary of State may prescribe, shall be imposed upon all probationers. (4) The studies of the probationers shall be controlled on behalf of the Secretary of State by the director of Indian forest studies (hereafter styled the director). (5) The director shall be a selected officer of the Indian Forest Service, shall be paid such salary as the Secretary of State may determine, and shall hold office for a term of five years.

LONDON.—It is understood that the residue under Sir Francis Galton's will is bequeathed to the University for the encouragement of the study of eugenics. During his lifetime the testator gave a considerable sum of money to the University for the establishment and maintenance of the eugenics laboratory at University College, and it is presumed that permanent provision will now be made for the continuance of the work of the laboratory.

OXFORD.—The following is the text of the speech delivered by Prof. Love in presenting Prof. Edgeworth David for the degree of D.Sc. *honoris causa* on February 7:—"Adest Tannatt Willelmus Edgeworth David, Geologiae praeclarus auctor. Huic viro accepta referenda sunt fere omnia; quae de ratione geologica et antiquis caeli vicissitudinibus, quibus usa est Australia, comperta habemus. Velut hic inventus est qui doceret continentem illam glacie oppletam fuisse eo tempore cum silvae densissimae, in carbonem hodie conversae, Britanniam nostram tegerent. Huius etiam laus est, quod, cum corallinum quoddam dorsum Oceano Australi supereminens usque in mille pedes terebraret, et omnia saxi frusta, summa, media, infima inspiceret, rationem Darwinianam de eiusmodi insularum ortu confirmare potuit. Quattuor abhinc annos novis Argonautis interfuit continentem Antarcticam exploraturis, quibus id potissimum munus propositum erat ut Australis Zonae magneticum, quem vocant, polum accuratissime definirent. Cuius rei causa itinere periculoso et laboris maximi suscepto huius praesertim viri scientia atque constantia feliciter navata sunt omnia. Nescio an nulli vel Borealis vel Australis poli exploratores tantos scientiae fructus reportaverint, quem eventum huic nostro David imprimis deberi censeo."

Prof. H. H. Turner, F.R.S., has been appointed Halley lecturer for the year 1911.

The statute on faculties and boards of faculties was again taken into consideration by Congregation on February 14, and the remaining amendments, thirty in

number, were disposed of. The statute as amended has now to pass the ordeal of Convocation, in which assemblage both non-residents and residents have a vote.

THE Board of Education is arranging to hold the Imperial Education Conference on April 25–28 next. The conference will be attended by representatives of all the Home Education Departments, English, Scotch, and Irish, and from most British dominions. It is proposed to devote the first two days of the conference to the consideration of problems connected with school education and the training of school teachers, and the last two days of the conference to the consideration of problems connected with education after the school stage and of certain administrative problems.

WE learn from *Science* that the Smithsonian Institution is about to come into possession of a bequest by the recent death of Mr. George W. Poore, of Lowell, Mass. His will provides, after certain minor legacies, that the residue of his estate be given to the Smithsonian Institution to form the Lucy T. and George W. Poore Fund, the income of which is to be used for the purposes for which the institution was founded. Mr. Poore explains in his will that he makes this bequest in the hope that "it will form an example for other Americans to follow by supporting and encouraging so wise and beneficent an institution as I believe the Smithsonian Institution to be."

SIR HENRY ROSCOE, chairman of the Appeal Committee for the new chemical laboratories at University College, London, has issued a further letter with reference to the appeal. As announced in NATURE of February 2, the sum of 25,000*l.* required for the site of the laboratories has fortunately been acquired. It is now desirable to make use of the site as quickly as possible by erecting the chemical laboratories on it. The estimated cost is about 50,000*l.* The president and committee are particularly anxious that this amount should be raised by Easter in order that the building may be begun this year, and may in this way be associated with the year of the King's Coronation. Gifts and promises can be addressed to his Royal Highness Prince Arthur of Connaught, or to Sir Henry Roscoe at University College, London.

A MEETING was held at Aligarh on January 10 at which it was decided to form a committee to be called "The Committee for the Foundation of a Mohammedan University," and to ask his Highness the Aga Khan to accept the office of president. We learn from *The Pioneer Mail* that many distinguished persons in India have accepted the office of vice-president, and that a representative committee has been appointed. The members of the committee include all trustees of the M.A.O. College, all members of the college and school staffs of Aligarh, all members of the central standing committee of the All-India Shia Conference, all editors of Mohammedan journals, and many representatives of other public bodies. Provincial committees are to be formed in each province, and the local committees of the M.A.O. Educational Conference are to be asked to become local branches of this committee. An appeal in various languages has been widely circulated, and the movement seems likely to be successful. A Reuter message from Calcutta on February 12 states that his Highness the Aga Khan and the Nawab of Rampur have each given 10,000*l.* towards the scheme for the foundation of this Mohammedan university at Aligarh. The donations to the fund now amount to about 66,660*l.* The Aga Khan confidently expects that the subscriptions will amount to twice this amount by March.

THE ninth annual report, for the year 1909–10, of the executive committee of the Carnegie Trust for the Universities of Scotland was adopted at the annual meeting of the trust on February 7. In connection with the endowment of research, the reports of the independent authorities who have examined the records of the year's work under the research scheme of the trust give evidence that its past success is being well maintained. The committee acknowledges the assistance rendered by the universities in providing the scheme with so many able workers, and in affording accommodation and supervision in their various laboratories. In the laboratory of the Royal College of Physicians, which in the department of medicine has taken a prominent share in the trust's scheme, the record of work for the past year is equally encouraging. The expenditure for 1909–10 upon the scheme of fellowships, scholarships, and grants, and upon the laboratory, was respectively 6824*l.* and 2454*l.*, towards the latter of which the Royal College of Physicians and the Royal College of Surgeons together contributed 1025*l.* The class fees paid in the universities and extra-mural colleges amounted during the year to 48,540*l.*, an increase of 1184*l.* as compared with the preceding year. The average amount paid per beneficiary was 12*l.* 12*s.* 9*d.* The expenditure left a balance of 1240*l.* to the credit of the scheme of payment of class fees, but as the statistics already to hand show an excess of expenditure of 2552*l.*, it is unlikely that any credit balance will remain at the close of the current year. The committee thinks a stage has been reached in the administration of the scheme of payment of class fees at which it becomes the duty of the committee to direct the special attention of the trustees to its operation in the past, and the modifications which now appear to be necessary. The committee is of opinion that it cannot secure itself against a deficit in future years under the present system, and that the scheme must be amended without delay. The first step it has taken is to announce that after the close of the current year it cannot continue to pay the fees in full, but must avail itself of the provision in the trust deed to pay in whole or in part. It follows that the system of paying for separate classes must be abandoned, and it is suggested that some scheme of paying a portion of the composite or inclusive fees for the several faculties shall be considered. A table published as an appendix to the report shows that up to September 30 seventy-five beneficiaries had voluntarily refunded the class fees paid by the trust on their behalf, amounting in all to 1689*l.*

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 9.—Sir Archibald Geikie, K.C.B., president, in the chair.—V. H. **Veley** and W. L. **Symes**: Certain physical and physiological properties of stovaine and its homologues. The bodies in question comprise the methyl-, amyl-, phenyl-, and benzyl-homologues of stovaine, and in addition a new compound recently prepared by M. Fourneau, viz. the propyl ester of dimethyl-amino-oxybenzoyl-isobutyric acid. The densities of these diminish with increasing molecular weight, and the affinity value of the last-named is less than that already found by the former of the authors for stovaine and for its methyl homologue. Fourneau's new compound abolishes the contractility of muscle less rapidly than does stovaine or methyl-stovaine. It has also less effect on blood pressure and on respiration. Amyl-, phenyl-, and benzyl-stovaine appear to act more slowly on muscle than does stovaine, presumably on account of partial precipitation of their bases. On blood pressure, amyl-stovaine has rather more effect than has stovaine. The pronounced local anæsthetic properties possessed by all these bodies are discussed in the following paper.—W. L. **Symes** and V. H. **Veley**: The effect of some local anæsthetics on nerve. The bodies dealt with in the preceding paper have been compared with one another, and also with cocaine, as to their effects in blocking the physiological conductivity of frog's nerve. The anæsthetic block produced by these bodies, when complete for maximal single stimuli (Berne coil at 400 mm.), is also complete for single stimuli many times more intense (Berne coil at 200–100 mm.). A block complete to maximal single stimuli (coil at 400 mm.) is usually also complete to repeated stimuli with the same disposition of the coil. Partial blockage of individual nerve fibres has not been detected. Stovaine, its homologues, and Fourneau's new salt all block more actively than does cocaine. Stovaine, methyl-stovaine, and Fourneau's new salt block more rapidly than do the remaining bodies. Amyl-, phenyl-, and benzyl-stovaine block more slowly, and the resulting block is less rapidly washed out. Considered as local anæsthetics, phenyl- and benzyl-stovaine offer no advantage over the remaining bodies. Amyl-stovaine may

be of value on account of the relatively long duration of its effect. Methyl-stovaine is the least readily decomposed by faintly alkaline fluids such as lymph and cerebro-spinal fluid. Fourneau's new salt has the least effect on circulation and on respiration.—F. F. **Blackman** and A. M. **Smith**: Experimental researches on vegetable assimilation and respiration. VIII.—A new method for estimating gaseous exchanges of submerged plants. The plant is enclosed in a glass chamber, a current of water is kept flowing through the chamber, and samples of the affluent and effluent liquid are analysed at frequent intervals. The alteration in the amount of CO_2 in solution which the liquid undergoes in passing over the plant in the chamber is the measure of the respiration or assimilation that is taking place. For experiments on assimilation, the liquid supplied to the chamber can be enriched with any desired amount of CO_2, and by a special use of a CO_2 generating tower the amount of this gas dissolved can be kept constant for a long period of time. The glass chamber containing the plant is sunk in a large copper water-bath with a glass window, and the temperature and illumination can be controlled. When the conditions allow vigorous assimilation, much oxygen is given off as bubbles from the plant in the chamber, and these bubbles take up an appreciable amount of CO_2 from the solution. It is therefore necessary to collect and measure this gas and use it as a correction to the apparent diminution in the dissolved CO_2. The gas is separated from the liquid by a valve at the highest point of the apparatus, and collected automatically for analysis. This method has none of the limitations of the bubble-counting procedure exclusively employed previously for the investigation of the assimilation of water-plants, and, since it takes account of the CO_2 in solution and also of that in the gas bubbles, critical measurements can now be made of the assimilation throughout the whole range of the external factors that primarily control this function.—F. F. **Blackman** and A. M. **Smith**: Experimental researches on vegetable assimilation and respiration. IX.—On assimilation in submerged water-plants and its relation to the concentration of carbon dioxide and other factors. The experiments were carried out by a new method, which takes account of the alteration of the gases in solution as well as of the gases liberated as bubbles. The aim is to demonstrate the *nature* of the relation between assimilation and the chief environmental factors—CO_2 supply, light-intensity, and temperature. The relation is such that *the magnitude of this function in every combination of these factors is determined by one or other of them acting as a limiting factor.* The identification of the particular limiting factor in any definite case is carried out by applying experimentally the following general principle:—*When the magnitude of a function is limited by one of a set of possible factors, increase of that factor, and of that one alone, will be found to bring about an increase of the magnitude of the function.* From the data obtained, a new type of diagram is constructed, by which it is possible to foretell what value of assimilation in Elodea will be attained in any combination of medium magnitudes of the three factors of the environment. In this diagram, against the different values of assimilation as ordinates, are ranged three separate curves showing the degrees of CO_2 supply, temperature, and illumination, which are respectively essential for the attainment of each value of assimilation. For any hypothetical combination of the factors, it follows, by the principle of limiting factors, that if the three functional values corresponding potentially to these be ascertained from the diagram, then the actual magnitude of assimilation attained with that combination of factors will always be *the smallest of the three potential values.* The last section contains a critical account of the work of previous investigators who interpreted their results on the assumption that there was *a primary optimum* in the relation between assimilation and each external factor. The substantial work of Pantanelli led him to the conclusion that the position of the optimum for any one factor shifts with the magnitude of the other concurrent factors. This can only be a transitional point of view, and from this we have advanced to the standpoint that *the whole conception of optima in this connection is inapplicable*, and breaks down completely on careful analysis. The authors show in detail that all the experiments of previous workers are more harmoniously interpreted from the point of view of interacting limiting factors than by the conception of optima.

Geological Society, January 25.—Prof. W. W. Watts, F.R.S., president, in the chair.—H. H. **Thomas**: The Skomer volcanic series (Pembrokeshire). The rocks are traceable on the mainland from near St. Ishmaels on Milford Haven to Wooltack Head, and on the west occupy the islands of Midland, Skomer, and the Smalls. The thickness exposed is some 3000 feet, and the lateral extension some twenty-five miles. The chief evidence indicates that the rocks are of pre-Upper Llandovery age, but, from a consideration of the geology of the neighbouring country, it is probable that their true age is Arenig. The rocks are chiefly subaërial lava-flows, frequently interstratified with red clays They are separated into two main groups by a mass of sedimentary rocks barren of fossils. The lavas form well-defined groups. The rocks fall into eight chief types, two of which are of necessity new; in order of increasing basicity they are:—soda-rhyolites, soda-trachytes, keratophyres, skomerites, marloesites, mugearites, olivine-basalts, and olivine-dolerites. The first five types may be included in the alkaline class; they are rich in soda, and most of the felspars belong to albite-oligoclase varieties. The last three types are normal subalkaline rocks, in which the felspars range from oligoclase to labradorite.

February 8.—Prof. W. W. Watts, F.R.S., president, in the chair.—Prof. T. W. Edgeworth **David** gave an account of the researches pursued by him, in conjunction with Mr. R. E. Priestley, geologist to the British Antarctic Expedition of 1907–9, in the course of that expedition, more especially the investigations connected with glacial geology.

Physical Society, January 27.—Prof. C. H. Lees, F.R.S., vice-president, in the chair.—Prof. F. T. **Trouton**: A demonstration of the phase difference between the primary and secondary currents of a transformer by means of a simple apparatus. The apparatus is a primitive induction motor consisting of two horseshoe electromagnets with their axes coincident and vertical, and their planes at right angles. Above the poles a copper disc is pivoted. The primary current from a transformer is sent through one magnet and the secondary current through the other. With a suitable phase difference a rotating magnetic field is thus obtained. Inserting an iron core into the transformer diminishes the speed of rotation. A steel core will produce a greater negative rotation than an iron one. To demonstrate the hysteresis effect, it is necessary that the core should consist of a bundle of fine wires, otherwise the Foucault currents set up will introduce a lag. The effect of Foucault currents can be shown by introducing another coil within the transformer in place of the iron core and closing its circuit with a variable resistance.—Prof. J. A. **Fleming**: A note on the experimental measurement of the high-frequency resistance of wires. The author refers to a paper read by him in December, 1909, before the Institution of Electrical Engineers, on quantitative measurements in connection with radio-telegraphy (Journal Inst. Elec. Eng., vol. xliv., p. 349, 1910), in which he described an apparatus consisting of a differential air thermometer having tubular bulbs into which similar wires could be placed, and by means of which a comparison could be made of the high-frequency (H.F.) resistance R' of a straight wire and its steady or ohmic resistance R. If two equal wires have passed through one a steady current A, and through the other a H.F. current A_1, then if these currents are adjusted until the rate of heat evolution in each case is the same, we have $A^2R = A_1{}^2R'$. Certain precautions are described in the paper for eliminating inequalities, but by means of correct reading H.F. ammeters as devised by the author, the ratio of the resistances R'/R can be determined from the ratio of the mean square currents $A^2/A_1{}^2$.—Prof. J. A. **Fleming** and G. B. **Dyke**: The measurements of energy losses in condensers traversed by high-frequency electric oscillations. In this paper an arrangement of apparatus is described for the purpose of measuring the internal energy losses in condensers traversed by high-frequency (H.F.) currents. It is shown that these energy losses in condensers may be considered as if they were due to a resistance loss in a hypothetical resistance in series with the condenser, the

condenser itself being supposed to have a perfect non-dissipative dielectric of the same dielectric constant.—Prof. J. A. **Fleming** and G. B. **Dyke**: Some resonance curves taken with impact and spark-ball dischargers. In the course of the experiments described in the previous paper on the measurement of energy losses in condensers, a large number of measurements had to be made with the cymometer of the frequency of oscillations in, and the inductance of, the secondary or condenser circuit. It was then an easy matter to draw complete resonance curves in each case, and this has accordingly been done with both the impact and spark-ball dischargers in the primary circuit, and for various resistances in the secondary circuit.

Mathematical Society, February 9.—Dr. H. F. Baker, president, in the chair.—E. **Cunningham**: The application of the mathematical theory of relativity to the electron theory of matter.—G. B. **Mathews** and W. E. H. **Berwick**: The reduction of arithmetical binary forms which have a negative determinant.—H. **Bateman**: Certain vectors associated with an electromagnetic field and the reflection of light at the surface of a perfect conductor.

CAMBRIDGE.

Philosophical Society, January 23.—Sir George Darwin, K.C.B., F.R.S., president, in the chair.—W. A. D. **Rudge**: (1) A constant temperature, porous plug experiment; (2) observations on the surface tension of liquid sulphur.—A. E. **Oxley**: The magnetic susceptibilities of certain compounds.

MANCHESTER.

Literary and Philosophical Society, January 24.—Mr. Francis Jones, president, in the chair.—Dr. A. N. **Meldrum**: The development of the atomic theory: (5) Dalton's chemical theory. The paper deals first with the principles, and afterwards with the genesis, of Dalton's chemical atomic theory. It is shown that it is impossible to suppose that the hypothesis of Avogadro had any influence on Dalton whilst engaged on the theory, the main principles of which are:—(1) that atoms of different kinds tend to combine in the proportion 1 : 1 rather than in any other, that the next proportion to occur is 1 : 2, then 1 : 3, and so on, and (2) that when two compounds of the same two elements are gaseous, the lighter is binary and the heavier tertiary. Dalton's explanation of them shows that Newton's postulate of similar particles, which are "mutually repulsive," was the fundamental idea of the chemical as it had been of the physical atomic theory. The author concurs with Roscoe and Harden in rejecting the account of the genesis of the theory which connects it with the discovery of the composition of marsh gas and olefiant gas, but is unable to accept their view, the gist of which is that Dalton first satisfied himself that the atoms of different gases have different sizes, and then devised the chemical theory. He concludes that it was Dalton's experiments on the combination of nitric oxide and the oxygen of the air that aroused his attention and made him apply his physical theory to the purposes of chemistry.—Prof. A. H. **Gibson**: The behaviour of bodies floating in a free or a forced vortex. The main conclusions drawn from the experimental results embodied in the paper are:—(1) In a free vortex. (*a*) Very small floating particles rotate in spiral paths, approaching with a continually increasing velocity, and finally disappearing down the funnel of the vortex. (*b*) If of moderate dimensions, the behaviour depends on the shape, size, weight, and position of the centre of gravity of the object, the lighter particles approaching more rapidly than those of a lower specific gravity. With homogeneous bodies of the same specific gravity, depth of immersion, and shape of plane of flotation, the larger shows the greater tendency to approach the centre. (2) In a forced vortex:—(*a*) Small bodies approach the centre with a radial velocity which is greater the greater the radius of rotation. (*b*) In homogeneous bodies of the same size and shape, the heavier shows the lesser tendency to approach the centre. (*c*) A non-homogeneous body shows a lesser tendency to approach the centre than does a homogeneous body of the same size, shape, and weight. If the centre of gravity of the non-homogeneous body is sufficiently low, the body works out to the outer edge of the vortex. (*d*) The shape of the body in itself has no effect on its behaviour so long as the vortex is a true forced vortex. As in the case of the free vortex, the knowledge of the forces called into play is adequate for an explanation of all the observed phenomena.

DUBLIN.

Royal Irish Academy, January 23.—Dr. H. F. Barry, vice-president, in the chair.—D. R. **Pack-Beresford** and Nevin H. **Foster**: The woodlice of Ireland, their distribution and classification. Twenty-five species of woodlice (Crustacea Isopoda Terrestria) are found in Ireland, and of these four species have been recorded from and are common in every county. Sketch-maps are given which show at a glance the various Irish county divisions in which each species has been taken. A series of synoptical tables is also included in the paper, which should prove useful in enabling students to diagnose any British species. Two plates illustrating *Metoponorthus melanurus*, B. L., and *Eluma purpurascens*, B. L. (species which have not yet been found in England), and a comprehensive bibliography, are also included.—John **MacNeill**: The early population-groups of Ireland, their nomenclature and chronology. The object of the paper was to distinguish the different classes of group-names found applicable to Irish population-groups in early times, and to assign an approximate period of origination to each class of names. The formulæ of the earlier names were distinguished and discussed, and a list drawn up under each formula. The paper dealt with the classification of the groups as free, tributary, and unfree, and identified the civil and military organisations of the petty States in ancient Ireland with the earliest traditional form of the Roman State.

Royal Dublin Society, January 24.—Prof. T. Johnson in the chair.—Prof. W. **Brown**: Mechanical stress and magnetisation of nickel, part ii., and the subsidence of torsional oscillations in nickel and iron wires when subjected to the influence of longitudinal magnetic fields. The results of experiments on magnetisation and torsion of nickel wire showed that a limit to the twist of the free end of the wire is reached with a certain definite longitudinal load. It was also shown by means of the subsidence of torsional vibrations that the greatest internal friction in the wire took place when it was surrounded by a longitudinal magnetic field of the same value as that in which the maximum twist occurred with a given load on the wire.—Dr. W. E. **Adeney**: The estimation of the organic matters in unpolluted and polluted waters with potassium bichromate and sulphuric acid. The investigations have been made with the view of discovering a rapid and accurate method of estimating the total oxidisability of the organic matters in unpolluted and polluted waters. The water is treated under suitable conditions, which are detailed in the paper, with a decinormal solution of potassium bichromate and sulphuric acid, and, after evaporation and digestion for a sufficient time in the water bath, the excess of bichromate remaining is determined by means of a decinormal solution of ferrous sulphate. The results of a number of estimations of a variety of waters are given, and they show that the method is capable of yielding concordant and accurate results.—Prof. Henry H. **Dixon**: The thermo-electric method of cryoscopy. The apparatus used in this method was devised in order to determine the freezing points of small quantities of solutions. With special devices for eliminating thermo-electric errors, it has been found possible, using one pair of junctions formed of copper and "eureka" alloy, to determine the freezing points of a 1 c.c. of solution with accuracy to 0·01° C. With a greater number of junctions greater accuracy may be attained. The method is particularly suitable for detecting very small differences of freezing point.

PARIS.

Academy of Sciences, February 6.—M. Armand Gautier in the chair.—P. **Idrac**: New observations on the spectrum of Nova Lacertæ (see p. 523).—Henri **Villat**: The discontinuous motion of a fluid in a canal containing an obstacle.—A. **Korn**: The helicoidal state of electrical matter: some new hypotheses for explaining mechanically electromagnetic phenomena.—Gaston **Gaillard**: Researches on the influence of velocity on the compass. At the high speeds attained in modern destroyers there is a possibility that the velocity may affect the indications of the compass. Some experiments in this direction have been carried out on a railway at speeds

between 80 and 120 kilometres per hour. The results obtained, so far, are inconclusive.—G. **Sagnac**: Optical systems in motion and the translation of the earth.—A. **Leduc**: The application of the Lenz principle to the phenomena accompanying the charge of condensers.—L. **Décombe**: A physical interpretation of non-compensated heat.—A. **Lafay**: A method of observation of the trajectories followed by the elements of an air current deflected by obstacles of variable forms. As an indicator, a gas is used the refractive index of which is higher than that of air, but approximately the same density. Such a gas casts a sharp shadow on a screen, and hence the motion of the air currents can be followed. Acetylene, a mixture of acetylene and carbon dioxide, and ethylene are suggested as suitable for this method of working.—MM. **Chéneveau** and **Heim**: The extensibility of vulcanised indiarubber.—G. **Friedel** and F. **Grandjean**: The structure of liquids with focal conics.—Louis **Matruchot**: A new fungus pathogenic to man. This fungus, to which the name *Mastigocladium Blochii* has been given, has been obtained in pure cultures direct from the lesions in man, and hence appears to be the sole cause of the diseased condition observed.—T. **Klobb**: The dextrorotatory phytosterols (anthesterols) from *Anthemis nobilis*.—Gabriel **Bertrand** and R. **Veillon**: The action of the Bulgarian ferment on the monobasic acids derived from reducing sugars.—A. **Marie** and M. **MacAuliffe**: Comparative measurements of individuals of both sexes from lunatic asylums with normal men and women. The inmates of the asylums are generally smaller than the normal, especially in the bust. Details of the comparison of various limbs and parts of the body are also given.—E. **Deschamps**: The treatment of epilepsy of gastro-intestinal origin. Remarks on a recent note of M. Doumer on the same subject.—A. **Bonnet**: Researches on the causes of the variations of the aërial entomological faunule.—M. **Gignoux**: The layers containing *Strombus bubonius* in the western Mediterranean.—J. **Bosler**: The relations between the earth currents and magnetic disturbances.—M. **Birkeland**: The zodiacal light.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 16.

ROYAL SOCIETY, at 4.30.—The Constitution of the Alloys of Aluminium and Zinc: Dr. W. Rosenhain and S. L. Archbutt.—The Production and Properties of Soft Röntgen Radiation: R. Whiddington.—Experiments on Stream-line Motion in Curved Pipes: Prof. J. Eustice.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Research Meeting. Some Antarctic Problems: Prof. Edgeworth David, F.R.S.

LINNEAN SOCIETY, at 8.

ROYAL INSTITUTION, at 3.—Problems of Animals in Captivity: P. Chalmers Mitchell, F.R.S.

ILLUMINATING ENGINEERING SOCIETY, at 8.—*Discussion* on School Lighting. Openers: Dr. James Kerr and Dr. N. Bishop Harman.

FRIDAY, FEBRUARY 17.

ROYAL INSTITUTION, at 9.—The Stimulation of Digestive Activity: Prof. H. E. Armstrong, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting. *Further discussion*: Modern Electrical Dock-equipment, with Special Reference to Electrically-operated Coal-hoists: W. Dixon and G. H. Baxter.

MONDAY, FEBRUARY 20.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Composition of the Acids flowing from the Thompson Displacement Apparatus for the Manufacture of Guncotton: G. W. MacDonald.—(1) Ammonium Sulphate and its Instability; (2) The Hydrolysis of Ammonium Salts: Watson Smith.—A Study of some Reactions in Gels: Emil Hatschek.—A New Still Water Calorimeter: J. H. Coste and B. R. James.

ROYAL SOCIETY OF ARTS, at 8.—Brewing and Modern Science: Prof. Adrian J. Brown.

VICTORIA INSTITUTE, at 4.30.—Science in Relation to Christian Missions: Rev. F. Baylis.

TUESDAY, FEBRUARY 21.

ROYAL INSTITUTION, at 3.—Heredity: Prof. F. W. Mott, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—Report on the Deaths which occurred in the Zoological Gardens during 1910: Dr. H. G. Plimmer, F.R.S.—On *Tragelaphus buxtoni*, an Antelope from Abyssinia: R. Lydekker.—A Contribution to the Study of the Variations of the Common Salamander (*Salamandra maculosa*): E. G. Boulenger.—On a Collection of Fishes from the Lake Ngami Basin, Bechuanaland: G. A. Boulenger, F.R.S.—Observations on different Gibbons of the Genus Hylobates now or recently living in the Society's Gardens, and on a *Symphalangus syndactylus*, with Notes on Skins in the Natural History Museum: Dr. F. D. Welch.

ROYAL ANTHROPOLOGICAL SOCIETY, at 8.15.—Prehistoric and Aboriginal Pottery Manufacture: Rev. J. W. Hayes.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Coast Erosion: W. T. Douglass.

ROYAL STATISTICAL SOCIETY, at 5.—The Fatality of Fractures of the Lower Extremity and of Lobar Pneumonia. A Study of Hospital Mortality Rates, 1751–1901: M. Greenwood, jun., and R. H. Candy.

WEDNESDAY, FEBRUARY 22.

ROYAL SOCIETY OF ARTS, at 8.—Water Finders: Prof. J. Wertheimer.

GEOLOGICAL SOCIETY, at 8.—The Geology of the Districts of Worcester, Robertson, and Ashton (Cape Colony): R. H. Rastall.—Geology of Northern Albania: Baron Ferencz Nopcsa, Jr.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, FEBRUARY 23.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Transmission of Flagellates living in the Blood of certain Freshwater Fishes: Miss M. Robertson.—Report on the Separation of Tonium and Actinium from certain Residues and on the Production of Helium by Tonium: Dr. B. B. Boltwood.—The Secondary γ-Rays produced by β-Rays: J. A. Gray.—The Specific Heat of Water and the Mechanical Equivalent of the Calorie at Temperatures from 0° to 80° C. With Additional Note on the Thermoid Effect: W. R. Bousfield and W. E. Bousfield.—On the Measurement of Specific Inductive Capacity: Prof. C. Niven, F.R.S.

ROYAL INSTITUTION, at 3.—Problems of Animals in Captivity: P. Chalmers Mitchell, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Long Distance Transmission of Electrical Energy: W. T. Taylor.—Extra High Pressure Transmission Lines: R. B. Matthews and C. T. Wilkinson.

FRIDAY, FEBRUARY 24.

ROYAL INSTITUTION, at 9.—Mouvement Brownien et Réalité Moléculaire: Prof. Jean Perrin.

PHYSICAL SOCIETY, at 5.—Flames of Low Temperature supported by Ozone: Hon. R. J. Strutt, F.R.S.—The Movement of a Coloured Index along a Capillary Tube, and its Application to the Measurement of the Circulation of Water in a Closed Circuit: Dr. Albert Griffiths.—An Optical Lever of High Power suitable for the Determination of Small Thicknesses and Displacements: E. H. Rayner.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design and Construction of Works for the Bacterial Purification of Sewage: R. J. Samuel.

CONTENTS.

THURSDAY, FEBRUARY 23, 1911.

PARKER AND HASWELL'S ZOOLOGY.

A Text-Book of Zoology. By Prof. T. J. Parker, F.R.S., and Prof. W. A. Haswell, F.R.S. Vol i., pp. xxxix+839. Vol. ii., pp. xx+728. (London: Macmillan and Co., Ltd., 1910.) Price 36*s*. net, the two vols.

AFTER an interval of thirteen years, this well-known text-book has appeared in a second edition. Its merits have earned for "Parker and Haswell" a high educational rank; the clear, terse descriptions of each selected example of the various classes; the comparison of the class with its exemplar; the abundance and excellence of the illustrations; the brief but useful summaries on general topics, distribution, history, variation. Its drawback has been that whilst containing a good two years' training in the subject-matter of zoology, it does not satisfy the needs of more advanced students. In some ways the new edition makes good this defect, but we are inclined to think that it would have been a gain if a good deal of elementary descriptive matter (such as students invariably obtain in other and smaller works) could have made way for fresh and much-needed descriptions of such examples as a tortoise and a mammal other than a rabbit, or for such a topic as comparative physiology.

The most striking change in the book is the improvement, both in text and in the figures, of the volume that deals with the invertebrata. The vertebrates, on the other hand, remain essentially unaltered. This differential treatment raises an interesting point, for it corresponds very closely with the relative amount of interest taken by students in the two branches of the subject and the relative progress, both in the presentation of, and research into, the subject-matter. Every experienced teacher knows—indeed, the book before us shows—that our knowledge of invertebrates has advanced more rapidly of late years and has a more attractive appeal than our knowledge of the vertebrata. Purely descriptive anatomy takes too large a place in the presentation of the latter. The discussions upon the origin of fins or the morphology of the ear-ossicles still sound on—vague, unsatisfying, unpragmatic. We do not expect our students to know in detail the sclerites of an insect, but we do expect them to know the hard parts of vertebrates. We still regard embryology as something distinct from anatomy, and the sense of dealing with the life-history of a vertebrate in the way in which life-histories are studied among invertebrates is never realised. Embryos are still treated as rarities, the phenomena of colour are omitted or passed over briefly, the questions of heat-production and other problems of vital mechanics are not mentioned. Is it to be wondered at that our students with rare exceptions devote themselves to research on invertebrata or to questions of heredity? A fresh treatment of vertebrate zoology is required. We regret that no attempt is made in this work to put new wine into the old bottles, but we cannot wonder at it. A new bottle is required.

With regard to the changes made in the first volume, the protozoa are more fully illustrated and described, but the accounts are not equally adequate. For example, the life-histories of the Lobosa are not referred to, the sexual dimorphism in *Sporozoa gregarinida* is not mentioned, and much recent work on forms mentioned or figured is not made use of. The list of fresh-water jellyfish and hydroids on p. 167 omits some interesting recent discoveries. It is, of course, incorrect to repeat the statement of the earlier edition that Limnocodium is only found in Regent's Park. A description of the actual mode of formation of a medusa would have been very welcome. Amongst the few mistakes of nomenclature we must mention Adamsia on p. 208 and on Fig. 157. The anemone referred to is obviously not Adamsia but *Sagartia parasitica* (to use the older name). The accounts of the various worm-Phyla are much improved and will prove extremely useful. The classification of the Crustacea is quite the modern one, but we miss any account of the recent work on parasitism and sex-production in this class. Fig. 454 is still incorrectly labelled. The treatment of the insects might have been brought a little more up-to-date in view of the increased interest in and knowledge of the housefly and the tsetse-fly, neither of which are noticed. The table of mouth-parts on p. 623 is reprinted without reference apparently to the work which had led to another comparison. The Aptera, a most important order, are treated very summarily, and no mention is made of the discoveries of Silvestri and Berlese, which have revealed since 1907 a new order, the Myrientomata.

These criticisms, however, do not preclude a generous estimate of the labour which these volumes have cost, nor do they seriously diminish one's estimate of their value. Prof. Haswell is to be congratulated on the appearance of this new edition, which will be greatly appreciated by all teachers, and in the matter of typography and lithography is an excellent example of modern English work.

F. W. GAMBLE.

PAINTS AND PAINTING.

The Materials of the Painter's Craft, in Europe and Egypt from Earliest Times to the end of the Seventeenth Century, with Some Account of their Preparation and Use. By Dr. A. P. Laurie. Pp. xv+444. (London and Edinburgh: J. H. Foulis, 1910.) Price 5*s*. net.

THE author of this interesting book, which belongs to a series treating of "The Arts and Crafts of the Nations," has gathered within its covers an immense amount of information concerning the materials and methods of painting in early times. Dr. Laurie has been, and is, an indefatigable investigator, especially in connection with ancient processes of mural painting and with the vehicles of mediæval and later days. His chief conclusions, some of which have been published before, as in the little volume on "Greek and Roman Methods of Painting," lately reviewed in these columns, are now made accessible to everyone interested in the subject. One has no longer to search through the back numbers of a journal

for scattered papers and lectures, but can find in the volume before us a *résumé* of his inquiries, with some additional information, as well as a list of works, old and new, which deal with some or other of the topics discussed in Dr. Laurie's pages. This list occupies nearly fifty pages, and is comprehensive if not precisely exhaustive.

Of the fourteen chapters into which this handbook is divided, not the least important is that which forms the introduction, in which a sketch is drawn of the interdependence of certain crafts, of the development of the processes of painting, of the increase in the number of available pigments, and of changes in the workshop and studio. Then in six successive chapters there are described Egyptian pigments and mediums, and classical methods, such as wax-painting, egg-tempera, and a kind of fresco-painting. The eighth chapter deals with the later history of fresco-painting, and then comes a series of discussions based on the treatises of the monk Theophilus and on the "Book of the Art," by Cennino Cennini. By means of abundant quotation from these authorities and by original comment, Dr. Laurie has certainly succeeded in reproducing "the atmosphere" described in the preface as that "in which these ancient works were carried out." As our author never loses his hold on modern science and modern practice, we commend his appreciative sympathy with the naïve descriptions and utterances of the older writers and historians of art.

"On the painting of illuminated manuscripts" is the heading of the eleventh chapter. There are here some indications of the pigments used in such wonderful productions as the "Book of Kells," and the "Lindisfarne Gospels," both of the seventh century. For instance, we learn that "the Irish monks had learned to extract the purple dye from a species of murex found on the shores of the Irish Channel." Besides Tyrian purple the early Irish illuminators had at their command red lead, several ochres, a green identical with malachite and several lakes. The ink they used is supposed to have owed its blackness entirely to carbon, but a close examination of the writing in the "Lindisfarne Gospels," recently made by the reviewer, indicates, by the presence of a multitude of reddish-brown spots, the employment of a gallo-tannate of iron, like that described by Theophilus. To the subject of lakes and other "adjective" colours, as used in ancient practice and in mediæval days, Dr. Laurie devotes a chapter of twenty-five pages; the employment of dyed cloths as sources of some pigments, as in the case of the red from kermes, or *Coccus ilicis*, is described.

The last two chapters in the book are mainly given up to the study of questions connected with the origin of oil-painting, the making and use of varnishes and the preparation of pigments and of canvas-grounds during the sixteenth and seventeenth centuries. Dr. Laurie admits that he is unable to pronounce definite judgments on all disputed points, but he has certainly contributed valuable material for a solution of some of the problems offered bv pictures supposed to have been painted in oil during the fifteenth century.

In the volume under review are included thirteen illustrations, many of them in colour. They are not merely pleasing enrichments of the text, but serve the purpose of throwing light upon certain descriptive passages.

On the whole, we may consider that the aim of the author has been satisfactorily accomplished and that he has given, within reasonable compass, a fair account, in English, of the varied information scattered very widely in the literature of the art of painting.

In a second edition the author must correct a few slips. For example, the two great lunettes painted by Lord Leighton in the Victoria and Albert Museum are not in true fresco (p. 136), but in spirit-fresco, an oleo-resinous vehicle containing wax. Again, Dr. Laurie has misplaced (p. 334) the Christian names of the brothers van Eyck. Revision is needed elsewhere also, as in the recommendation to use terre verte in true fresco-painting (p. 137); it has proved very treacherous in this country. Then, too, the attribution to Mr. James Ward of the "valuable suggestion, unknown to the older painters, namely, the introduction of asbestos into the plaster to bind it together" (p. 138), does not fit the circumstances. Mr. Ward in his "Fresco Painting," published in 1909, does, it is true, recommend this use of asbestos, but it had been so employed long before, and its adoption had been urged nineteen years previously in a well-known technical manual. A. H. C.

THE COLLOID STATE OF MATTER.

Kapillarchemie, Eine Darstellung der Chemie der Kolloide und verwandter Gebiete. By Dr. Herbert Freundlich. Pp. viii+591. (Leipzig: Akademische Verlagsgesellschaft m. b. H., 1909.)

THE attention which has been directed during recent years to the colloid state of matter has led to the publication of a very considerable literature, and the subject is rapidly becoming an important section of physical chemistry. We therefore welcome Dr. Freundlich's book as perhaps the most complete attempt to deal with the subject as a whole on the lines of a definite hypothesis, and bring it into clear mathematical relation to physics.

The colloidal state is usually, and possibly always, a two-phased condition, in which one finely-divided substance is suspended in another, and ranges by imperceptible gradation from such suspensions as clay in water or butter-fat in milk to true molecular solutions which to our present means of examination are absolutely homogeneous. In such systems the surfaces of contact between the two phases are of enormous area, and the phenomena of surface-action and especially of surface-tension have an importance of quite a different order to that which they possess in single phases. Dr. Freundlich, indeed, is inclined to consider them essential causes, not merely of the peculiarities of colloid solution, but of adsorption, coprecipitation, and electric cataphoresis, which often bear the closest resemblance to ionic chemical reactions. While, however, the influence of surface or surface-action is the guiding hypothesis of Dr. Freundlich's work, we have been particularly struck with the candid and truly scientific spirit in which he admits its limitations, and states opposing views.

Beginning with a discussion of the mathematical work of Laplace on surface-tension, the author points out that while it adequately expresses the effect as observed on curved surfaces, it gives no explanation of tension on plane ones, since it assumes the internal pressure to remain constant to the surface and to react vertically to it only. A more complete theory has been developed by van der Waals and his pupils. In the gas-equation, $(P+a/v^2)(v-b)=RT$, the a/v^2 represents the increase of pressure due to the mutual attraction of the gas molecules; and this, while only a trifling correction in gases, becomes an enormous pressure in liquids owing to the closeness of the molecules. When, however, a particle lies actually on the surface, it is only attracted by those below and around it, and not compressed by others above, so that the surface-layer is not only under a much lower pressure vertically, but the surface is under actual tension from the horizontal component of the attraction of the particles around and below it. Since the liquid particles not only exert attraction on others in the surface-layer, but on those of vapour or gas immediately above it, it is clear that the layer of rarefied liquid must pass without break into a layer of compressed vapour within the very small range of molecular attraction. Substances, like most salts, which dissolve with contraction of volume, increase of internal pressure, and diminution of vapour-pressure, also increase the surface-tension, while volatile liquids and many colloid organic substances diminish it.

It was first pointed out by Willard Gibbs, and afterwards, more fully, by J. J. Thomson, that bodies which diminish the surface-tension must tend to accumulate in that surface, while the reverse is the case with those which increase it. Freundlich sees in this the explanation of adsorption, positive and negative; and as such an effect on surfaces even between liquid and vapour can be shown experimentally to occur, it must be accepted as one of the causes, though whether it plays the important part which he assigns to it must remain uncertain until means are found at least of estimating its quantitative effect. Lagergren has suggested another physical theory of adsorption based on the idea that a surface is a region not of tension but of compression, and that substances which favour contraction of volume must accumulate there. While it seems impossible to accept the idea of a compressed layer at the surface of a liquid in contact with gas, it may well be that the liquid is compressed, and its surface-tension negative on solid surfaces, just as van der Waals assumes that gas is compressed on liquid ones, since the internal pressure and surface-tension of solids must be enormously higher than those of liquids. Neither theory adequately explains many of the individualities, both of absorbent surfaces and adsorbed substances, some substances being adsorbed at surfaces both of positive and of negative surface-tension, and one is inclined to believe, what indeed Freundlich admits, that chemical forces often come into play, and that adsorption resembles in many cases a sort of contact-solution of two bodies having chemical affinities, or, what is probably the same thing, opposite electric potentials.

H. R. P.

TRAVELS IN ICELAND.

Island in Vergangenheit und Gegenwart, Reise-Erinnerungen. By Paul Herrmann. Teil iii., Zweite Reise quer durch Island. Pp. x+312+map. (Leipzig: W. Engelmann, 1910.) Price 7 marks.

THIS volume, although complete in itself, is a sequel to the two parts of "Island in Vergangenheit und Gegenwart" (1907), describing Herr Herrmann's travels four years previously. As before, the town of Torgau allowed him the long leave, provided a *locum tenens* (as schoolmaster), and relieved him of all anxiety during the illness resulting from an accident on the journey. The money was provided for the undertaking by the higher educational authorities, and we cannot wonder when he observes, "Surely few towns would act so munificently." The same guide was employed—he who accompanied Thoroddsen on his explorations—but although the surrounding circumstances were equally favourable, the book does not give quite such an impression of enthusiasm for Iceland in each and every aspect as on the former visit.

The route was by sea round the eastern, western, and northern coast, descriptions being given of all places called at, and the scenery passed. Herr Herrmann is pleased to think his former books are used as reference by tourists, and this part of the present work is specially for their benefit. He thinks the number of visitors will greatly increase when the steamship service is improved. He complains greatly of the accommodation now provided, and quotes and agrees with the opinion of another traveller (O. Komorowicz) "that if such were used in Germany for the transport of animals the S.P.C.A. would interfere"!

From Reykjavik the journey as far as Uxahryggtr was over familiar ground, but a new route was struck thence to Kalmanstunga—with an excursion to the Surtshellir caves—and westward round the Snæfellsnes peninsula, where the inhabitants were not found as lacking in progressive spirit as from other accounts was expected. Northward to Hrofberg with an appreciative allusion to the agricultural school at Olafsdalur. Then eastward to Hólar, the seat of an ancient bishopric and present agricultural school, and southward over the Kjölur to Geysir.

When the disadvantages of storms, cold, tent-life, and many minor catastrophes were overcome, and the pleasant neighbourhood of Hvitárvatn reached, an attempt to visit Frodardalur resulted, owing to an overtaking storm, in a severe fall from the pony. As a result of this accident the remaining portion of the journey, by Skalholt, Gullfoss, and round Reykjanes to Reykjavik, is undertaken with less spirit.

The author enlarges more on the geological aspect of the country than in the preceding volumes; in the meantime he has learnt much in this direction, but wishes the scientific reader to remember always that the descriptions, remarks, and conclusions are those of a layman only. The more he knows of Iceland the more his admiration of Thoroddsen, as a geologist and explorer, grows, and this appreciation is expressed in many references.

For younger geologists the entirely or partially

unexplored regions are pointed out, with hints and advice for future students. The folklore of the island is never lost sight of, and many extracts from the Sagas, and much historical matter, are interspersed in smaller print than the bulk of the narrative.

The writer's love of Iceland is not lessened by his second, and, as he regretfully remarks several times, final visit. It is interesting to note that in his opinion the union between Iceland and Denmark is political only, and that the ties between the two peoples are not likely to become deeper or closer.

The work is illustrated by many photographs and drawings, and a map of the route followed. Altogether it is interesting reading for lovers of Iceland or for prospective travellers over the same ground, although the detailed accounts, evidently intended for future tourists, of the reception, food, lodging, and cost at each stopping place are wearisome.

We regret that Herr Herrmann, with one exception, always alludes to our countrymen with some contemptuous phrase; the four years' interval has not softened his attitude towards the British traveller.

M. G. B.

HEREDITY AND ITS PHYSICAL BASIS.

Hereditary Characters and their Modes of Transmission. By C. E. Walker. Pp. xii+239. (London: Edward Arnold, 1910.) Price 8*s*. 6*d*. net.

THIS volume deals very clearly and briefly with the whole field of heredity, but perhaps its most interesting feature is the development of a theory as to the relative share borne by the chromosomes and other parts of the sexual cells in the transmission of hereditary characters. Stated somewhat crudely, the theory and the arguments which support it are as follows:—In the chromosomes are represented new characters (*i.e.* individual variations, mutations, and the like), while other parts of the cell are concerned with the propagation of old-established racial characters. That the chromosomes do not bear entities representing all the inherited characters is shown, firstly, by experimental evidence, such as the fertilisation of enucleated Echinoderm ova. For instance, Godlewski fertilised enucleated eggs of sea-urchins with the sperm of crinoids and obtained gastrulæ which possessed pure maternal characters only. Second, through the reducing divisions half the chromatin is eliminated from the mature gametes. In spite of this, all the racial characters are shown by the individual which develops from the fertilised ovum. If one half the entities representing the racial characters of the father are absent from the sperm, it is so improbable as to be almost inconceivable that exactly those characters which are unrepresented will be supplied by the mother, seeing that the entities present in the ovum have been halved in number in a corresponding way.

Further, the racial characters are blended in inheritance, while individual variations and new characters are transmitted in a Mendelian way, the mechanism for which is supplied by the chromosomes. That the sexual characters also are propagated in this manner was suggested, first by Castle, who supposed that both sexes were heterozygous in this respect; that is to say, that each individual contained both maleness and femaleness, the one latent and the other patent. Difficulties in the way of accepting this theory were removed by the suggestion that one sex was homozygous, its sexual character being recessive, while the other was heterozygous, and showed the dominant character. Credit for this emendation is given by the author to Bateson and Correns, but by right of priority it belongs to Geoffrey Smith. The latter, in his Naples monograph on the Rhizocephala (published in 1906), suggests that in the case of crabs the male is heterozygous since it exhibits female characters when castrated by the parasite sacculina, and must therefore have femaleness latent. The female, on the other hand, under similar circumstances, never shows male characters. He further surmises that in some parthenogenetic forms the heterozygous sex was the female, since from it both male and female individuals were at times produced.

The ever-present question as to the inheritance of acquired characters comes up again for discussion, and the author, who largely follows the sane reasoning of Archdall Reid, concludes that they are not inherited. Among other arguments in support of this view he includes that from the transmission of the characters of neuter individual in ants. This argument, he says, he has only met with twice before, namely, in the "Origin of Species" and in Poulton's "Essays on Evolution." He will no doubt be interested to know that it figures very largely in the controversy between Weismann and Herbert Spencer, published in the *Contemporary Review* in 1893 and 1894.

One more point must be raised, namely, the use of the word "regression" to signify something the reverse of progression, instead of in the special sense, acquired through biometry, in which it is generally used. The author has followed Archdall Reid in this respect, who, in his "Principles of Heredity," speaks of variations consisting of the addition of a character as progressive, and those resulting in the loss of a character as regressive. We hope he will also follow him in altering "regression" and "regressive" to "retrogression" and "retrogressive" in future editions.

E. H. J. S

GEOLOGY MADE EASY.

Geologie Nouvelle. Théorie Chimique de la Formation de la Terre et des Roches Terrestres. By H. Lenicque. Pp. xvi+271. (Paris: A. Hermann et Fils, 1910.) Price 7 francs.

THE book before us is the work of an engineer, who, having discovered that the received doctrines of geology rest largely on unproved hypotheses, has been impelled to frame a new geology for himself. The French scientific journals having ungratefully met this by a conspiracy of silence, it is left for us to introduce it to the public.

This new light in the dark places of the earth comes, it would seem from the acetylene lamp; for in the principle of that useful invention the author finds the clue to many phenomena which geologists have explained in ways less sensational. Silicates and

carbonates are decomposed at the temperature of the electric furnace, where the stable compounds are silicides, carbides, phosphides, and the like. We are therefore bidden to believe that the heated interior of the globe consists of such bodies as calcium carbide and carborundum; and it is clear that, when some of these substances come into contact with water, startling consequences are to be expected. Thus is explained, for instance, the origin of limestones, setting aside some of late age which the author pronounces to be organic. Eruptions of lime, in a pasty state, were forced up by the pressure of acetylene gas, and spread over the sea floor. Any creatures so unfortunate as to be living in the neighbourhood were expeditiously converted into fossils. In like manner, shales and clays were produced by the action of water on silicides of aluminium and calcium, and were poured out in successive *coulées*, with equally painful results. After this, coal presents no difficulty. It was erupted as a hydrocarbon, more or less fluid, supersaturated with carbon, and such vegetable matters as it happened to encounter were carbonised by the coal itself.

An equal boldness of conception characterises the author's treatment of other branches of geology. Elevation and depression of continents being among the unproved hypotheses, we are offered instead a submergence of the northern and southern hemispheres in turn, resulting from the precession of the equinoxes. Glaciation, of course, finds a like explanation, as Croll has already taught; but our interest is more stirred by those prodigious movements of the ocean which result from the sudden collapse of a melting polar ice-cap. To cataclysms of this kind are referred, not only the deluge in the days of Noah, but the cutting of the Straits of Dover and the severing of Madagascar from Africa, and we gather that the same dread agency may have torn the reindeer from his northern home and transported him to sunny France, where his bones still remain to tell the tale.

Here we must reluctantly take leave of M. Lenicque, while assuring the curious reader that the theories which we have noticed are chosen from many others not inferior to them in novelty and ingenuity.

A. H.

ALL SORTS AND CONDITIONS OF WOMEN.

Women of all Nations. Popular edition. Edited by T. A. Joyce. Pp xii+220+65 plates. (London: Cassell and Co., Ltd., 1910.) Price 6*s.* net.

THOSE already familar with the former edition of "Women of All Nations" will recognise with what skill Mr. Joyce has dealt with it to reduce it to the present extremely convenient and informing little volume. Naturally, the popular edition is less copiously illustrated, but the plates retained are an excellent selection. The range of the book is exceptionally vast, as the title leads us to expect; we pass from criticisms of the modern British woman almost in the vein of Pierre de Coulevain to the chapter on Africa, where we read of girls fattened to attract suitors and of widows buried alive in their dead husband's grave. Women doctors confront us in many parts of the world; in fact, among the Madi of the White Nile they are the chief medical practitioners who receive fees, while the men only act as honorary surgeons (p. 150). The Madi women, we learn, fight duels; nevertheless, they are capital wives, and married life is very happy in their country. A Zulu lady doctor of very striking appearance is portrayed opposite p. 158.

The chapters on Europe (viii. to xv.) are extremely interesting, showing as they do how gradually East merges into West, and how numerous are the backwaters of civilisation in our very midst.

"Two hundred years ago the women of Russia lived in as much seclusion as if they had been Mohammedans. It was Peter the Great who first commanded them to lay aside their veils. . . . In Russian villages there are still old women who act as professional match-makers, and the peasant women still keep their heads covered out-of-doors, even in the warmest weather" (p. 104).

Austria affords an instance of the persistence of national points of view as seen in the status of Slav and Magyar women. A Slav proverb runs:—"That household is threatened with ruin in which the distaff rules and the sword obeys," while there is a Magyar saying that "it is the chignon that must rule." Italian law is exceptionally just to women (pp. 109–10); a married woman's property is absolutely her own,

"she has a right to the guardianship of her children, and, as a daughter, to an equal share with her brothers in any patrimonial inheritance in case of intestacy."

Unfortunately the space devoted to America is very brief, 34 pages, the whole of South America—all too scanty in the unabridged edition—being compressed into seven pages. We regret that Mr. Joyce has so greatly curtailed the section by himself on the Maori of New Zealand, and also the discussion of the racial, geographical, and sociological conditions affecting the position of Polynesian women. We are glad to find that the introduction is entirely omitted; it was certainly beneath the level of the rest of the book.

APPLIED MECHANICS.

(1) *Notes on Applied Mechanics.* By R. H. Whapham and G. Preece. Pp. vi+206. (London: Edward Arnold, 1910.) Price 4*s.* 6*d.* net.

(2) *Applied Mechanics, Including Hydraulics and the Theory of the Steam-Engine. For Engineers and Engineering Students.* By John Graham. Pp. viii+304. (London: Edward Arnold, n.d.) Price 5*s.* net.

(1) THIS little book is primarily intended for naval cadets, who are undergoing instruction in applied mechanics during their six months' cruise in the *Cumberland* and *Cornwall.* The examples at the end of each chapter, which are all fully worked out, illustrate, so far as possible, the application of the various principles discussed in each section to actual practical problems which are likely to be met with by the cadets in their future professional career; there is, therefore, a refreshing novelty in these examples, and they differ markedly from those usually met with in the ordinary text-books on this subject.

The first nine chapters deal with machines and such details connected with them as frictional losses, energy of moving masses, relative velocities and accelerations, and output of work. There is an excellent chapter on simple harmonic motion, in which many of the difficulties are smoothed away which generally worry the young student entering for the first time on the study of this branch of the subject. The latter half of the book is devoted to stress and strain, bending moments, shearing forces, and stresses in beams, the stresses and amount of twist in shafts when transmitting power, and the stresses in simple loaded frameworks; it is rather strange that the authors have entirely omitted to deal with the deflection of beams. The last chapter is devoted to a simple treatment of the problem of the flight of projectiles.

The two authors have succeeded in writing on a well-worn subject a text-book which will be welcomed by many young engineering students because of the clear and lucid way in which fundamental principles are explained and enforced.

(2) This book is based upon the lectures delivered by the author to the students at the Technical College, Finsbury, London, and it covers more ground than is usual in the case of the more advanced text-books on this subject.

The first thirteen chapters are devoted to a consideration of the laws of motion, work, and energy; friction; the energy of rotating masses; centres of gravity, &c. There is nothing novel in the treatment of the subject, but fundamental principles are clearly enunciated and explained, and fully worked out examples are freely used in order to illustrate the application of these principles to the many practical problems which the engineer is called upon to solve.

The next eight chapters deal with the branch of the subject usually termed "Strength of Materials." Two excellent chapters on simple harmonic motion, and the balancing of rotating masses, are included in these eight chapters; in any future edition it would be an advantage to print these chapters immediately after chapter x. of the present edition, as this is the correct sequence for them.

The remainder of the book is devoted to elementary hydraulics and to the elements of the theory of the steam engine, including in the latter case such problems as the effects produced by the inertia of the reciprocating masses, the dynamics of steam engine governors, valve gears, and their effect upon the steam distribution. A four-figure table of logarithms is printed as an appendix, and will prove useful to students who are working through the problems given at the end of the book. The book will probably prove useful to junior students in technical colleges.

OUR BOOK SHELF.

The Microscopical Examination of Food and Drugs. By Prof. H. G. Greenish. Second edition. Pp. xx+386. (London: J. and A. Churchill, 1910.) Price 12*s*. 6*d*. net.

THE general excellence of this standard work, which first appeared in 1903, is maintained throughout the second edition, and its usefulness is increased by the addition of a valuable section on adulterants and another on the practical examination of unknown powders. Other new subjects which have been introduced include notes on saffron and gentian, liquorice and calumba roots, and a description of a method of preparing fibres for cutting transverse sections. Otherwise no change has been made in the method of treating the subject-matter; and, indeed, none was necessary.

The first section deals with the various starches, complete instructions being given as to how to mount specimens for microscopic examination; the author describes the shape and appearance of the starch and explains how the grains can be sketched to their correct relative size. In subsequent chapters hairs and textile fibres, spores and glands, roots, woods, stems, leaves, flowers, barks, seeds, fruits, rhizomes, and roots are dealt with in an equally complete manner, and care has been taken to select types which will best illustrate the methods of examination described. With regard to foods, the book is essentially a treatise on practical methods rather than a complete guide to their examination.

In a future edition the inclusion of more foods would make the book of still greater use to analysts, but those at present included are well and adequately dealt with. In the very useful section on adulterants, oil cake might also have been treated from the point of view of the adulteration of oil cake itself; and, in passing, it may be noted, as a very minor point, that in giving the sources of oil cake, the author omits to mention cotton seed. The original illustrations are carefully drawn as to detail, and the drawings selected from other authorities are well chosen. The book will continue to be of great value to students and analytical chemists, as well as to those pharmacists who pursue their calling in its higher branches.

Child Problems. By Dr. G. B. Mangold. Pp. xv+381. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 5*s*. net.

IN this volume the author deals principally with facts and figures obtained from American sources, but the problems are similar to those which were brought into prominence in England in 1904, when evidence was given before the Interdepartmental Committee on the causes of physical deterioration. Prevention is better than cure, and the hope for the future must always be with the younger generation. In some respects America is ahead of England. The deplorable waste of child-life owing to preventible causes is recognised as a national concern, and in many of the States there is a more or less efficient supervision and regulation of the milk supply. Separate courts for children have been established for some years in several of the States, and the whole attitude of society towards the youthful delinquent appears to offer more chance of reforming him than does the English system. In other respects possibly America might learn from England, *e.g.* in regard to factory legislation.

Social problems appear under somewhat different aspects in different countries, but all civilised communities are beginning to realise that national efficiency depends on prevention of the causes which lead to physical deterioration, and a study of the social problems connected with childhood has world-wide application.

"The child is father to the man": the physical, moral, and intellectual welfare of the race depend on the inheritance, training and education of the children. Child problems are the gravest of our time and the present volume should prove helpful to all who are anxious to further reform. The subject matter is dealt with under five heads: infant mortality, educa-

tional reform, child labour, the delinquent child, the neglected child. The author insists on the importance of securing the cooperation of women, but he omits to point out that until they possess the power and status of citizenship their power of helping will be crippled. The volume can be warmly recommended as a wise and human study of immensely difficult and important questions. Its value is enhanced by a full biography and an index. The type is clear and the printing good.

Der Begriff des Instinktes einst und jetzt. Eine Studie über die Geschichte und die Grundlagen der Tierpsychologie. By Prof. Heinrich Ernst Ziegler. Second revised and enlarged edition. Pp. vi+112+2 plates. (Jena: Gustav Fischer, 1910.) Price 3 marks.

THIS is a revised and enlarged edition of a luminous essay which Prof. Ziegler contributed to the Weismann Festschrift in 1904. It deserves to be widely known as a terse and interesting introduction to comparative psychology. The treatment is in the main historical, and the author makes a point of showing how the conception of instinct has mirrored the progress of science.

From the views of the Greek philosophers, the Church, and the old Vitalists, the author passes to Darwin and the Lamarckians, and thence to modern comparative psychology, as represented by workers like Lloyd Morgan, Groos, and Zur Strassen. Ziegler himself, following Weismann, interprets instincts as the outcome of the selection of germinal variations; they are now part of the inheritance and are objectively represented by pre-established nerve-paths. In his discussion he insists upon keeping to an objective consideration, for it is impossible to discover how far the lower animals are conscious.

In contrast to instinctive behaviour, we may speak of intelligent behaviour when it is worked out by the individual's experiments, when it requires to be learnt, when it is individually adjusted to particular circumstances. But when we reflect how little we know, for instance, in regard to the distribution of feelings of pleasure and pain among animals, we see the advisability of trying to define the grades of behaviour as objectively as possible. The author is, therefore, resolute in leaving consciousness and feeling and perception of purpose entirely out of account in his conception of instinct. At the close of the volume—which is all too short—there is an interesting appendix showing how the brains of workers, queens, and males among ants and bees differ from one another, as their instincts do.

Licht und Farbe. By Robert Geigel. (Pp. 199. (Leipzig: Philipp Reclam, junr., n.d.) Price 60 pfennig.

THIS little book belongs to a collection of volumes on "natural science" published in the series known as the "Universal Bibliothek," which is so familiar to students of German literature in this country, and which, in Germany, by providing, at the lowest possible cost, translations of the masterpieces of foreign literature, has helped to make the best books in many languages known to all classes of readers. The price of the usual small volume or "unit" of about a hundred pages is 20 pf.: a number of such units may make one book; thus the "Nibelungenlied" extends to four "units," and may be bought for about tenpence. Three units go to make the present volume, which is illustrated by seventy-five drawings in the text, and, in addition, four coloured plates—as well as a photograph of the author—all well printed.

The aim of this volume is to give a simple, popular account of the properties of light, and especially of phenomena connected with variation in wave-lengths. or colour. From this point of view the ground covered is sufficiently extended: spectrum analysis, fluorescence, interference, polarisation, colour photography, meteorological optics, are all dealt with, in addition to the theory of instruments and photometry.

It would be idle to discuss such a book in any detail. In the nature of the case a work in German intended to give some popular account of elementary scientific ideas can have but little interest for English readers. Clerk Maxwell's "Matter and Motion" is a classic: this volume can pretend to no such distinction. We have not found it inspiring, and in lucidity it might be improved. There is a tendency to regard the general reader too much as a child, and in one instance at least the treatment is directly unscientific in giving as consequences of a law the facts which that law was invented to resume. On the whole, however, the book gives a tolerably readable elementary account of the branches of optics with which it is concerned, and no doubt will enable many a German to take an intelligent interest in matters in which he is not a specialist.

Catalogue of the Lepidoptera Phalaenae in the British Museum. Vol. x., Noctuidæ. (London: Printed by order of the Trustees, British Museum (Nat. Hist.). Price 20s.

THE tenth volume of this important work contains more pages than any which has yet been published, vol. vii., the largest of the preceding volumes, containing only 709 pages; and vol. ix. only 522, as against 829 pages in vol. x. The series of plates relating to vol. x. will include plates 148–173, and will be published early in 1911.

Vol. x. is devoted to the Erastrianæ, the thirteenth out of the fifteen subfamilies recognised by the author in the Noctuidæ, and contains descriptions of 1222 species (numbered from 4987 to 6197) belonging to 136 genera, a considerable number, both of genera and species, being described as new. There now remain only the subfamilies Hypeninæ and Hyblæinæ to complete the great group of Noctuidæ which, according to the provisional arrangement of families of Lepidoptera in the first volume of the present work, is only the fourth of fifty-two families, and is placed between the Agaristidæ and the Pterothysanidæ.

The Erastrianæ are moths of comparatively small size, and are very varied in their colour and markings, but the so-called "Noctud-pattern" is rarely present. "The subfamily is to a large extent confined to the tropical and warmer temperate regions, especially the more arid districts, and it has few species in the colder zones, and none in the Arctic and Alpine zones." A few species are British, but though some are abundant in special localities, they are not generally common.

The rapid progress which it has been found possible to make with so bulky and extensive a work is most remarkable, this being the second volume issued in 1910; and a volume appeared in each of the two preceding years.

Photography in Colours: A Text-book for Amateurs, with a Chapter on Kinematography in the Colours of Nature. By Dr. Geo. L. Johnson. Pp. viii+143. (London: Ward and Co., 1910.) Price 3s. 6d. net.

THE author has rewritten and enlarged the last section of his "Photographic Optics and Colour Photography," and in this volume issues it separately. Being "for amateurs," only those processes that are practically suitable for this class of workers are included, excepting the final chapter on kinematography. Indeed, the subject has been narrowed still further, for the only method treated of with any

fulness is the single-plate or screen-plate process. Here evidently the author writes with considerable experience and even enthusiasm, and as those parts that deal with the "autochrome," "dioptichrome," "Thames," and "omnicolore" plates have been revised by the respective makers of these plates, there is excellent guarantee that the details given are trustworthy.

There is always a difficulty when entering into particulars on such a subject, that commercial products are liable to vary, and it is often impossible for one person to know the extent of this variation in every section of the subject. Just one example will indicate the need for bearing this in mind. Dr. Johnson says of the "dioptichrome" plate that the "first black condition is very perfectly fulfilled." That means that the red, green, and blue patches on the colour screen are so proportioned that the general colour presented to the eye is a pure grey. We have just examined two screens of this make, and one is a rather fine green and the other pinkish. The preliminary chapters on the eye, colour vision, and colour blindness, although short, are of much interest.

Tables for Calculation of Rock-Analyses. By Alfred Harker, F.R.S. (Cambridge: University Press, 1910.) Price 1*s*.

CHEMICAL analyses of rocks are constantly becoming more refined and complete, and, in consequence, if accurately interpreted, are of increasing value to the petrologist. Systems of rock-classification that depend on chemical composition are also now in favour. For these and other reasons it becomes desirable that the percentages of components as stated in a rock-analysis should be translated as easily as possible into percentages of the constituent rock-forming minerals. Mr. Harker's tables are designed to meet this want, and they have so many valuable features that they should be in the hands of all teachers of petrology. They are very compact, and consequently are cheap compared with the books hitherto in use for this purpose; much time may be saved by their use and long calculations avoided. The method adopted is simple and exceedingly ingenious, and with these tables a student who has not hitherto attempted calculations of this sort may make them more rapidly and even more accurately than by any of the methods formerly in use.

Populäre Vorträge aus dem Gebiete der Entwickelungslehre. By Dr. Wilhelm Breitenbach. Pp. vi+264. (Brackwede i. W.: Verlag von Dr. W. Breitenbach, 1910.) Price 3 marks.

THIS little book consists of six popular lectures, dealing respectively with the origin of life, recent theories of heredity, fifty years of Darwinism, Fritz Müller, the prince of observers, Hermann Müller, and the history of the human race. They are written in a clear and interesting style, and, apart from their scientific value, may be strongly recommended to English students of biology who desire to improve their acquaintance with the German language.

Open-air Studies in Botany: Sketches of British Wild Flowers in their Homes. By R. L. Praeger. Second edition, revised. Pp. xiii+266. (London: Charles Griffin and Co., Ltd., 1910.) Price 6*s*. net.

THE first edition of this book was reviewed in NATURE of June 16, 1898 (vol. lviii, p. 150). The present issue has been revised throughout, but little alteration has been made. The nomenclature has been changed where necessary to follow that used in the "List of British Seed-plants and Ferns," published by the British Museum in 1907.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Perpetual Calendar.

I CANNOT allow the article signed by "W. T. L." in NATURE of February 2 to pass without a protest. The proposal to make "New Year's Day" a *dies non*, named "New Year's Day," and not a day of the week or of the month, emanated, I believe, from Mr. Alexander Philip, of Brechin. Supposing that January 1 were a Sunday, and supposing that March, June, September, and December were given 31 days, the other months 30 each, February 1 would always fall on a Tuesday, March 1 on a Thursday, and so on. This would save much trouble in arranging dates for meetings. But, more important still, the four "quarters" of the year would be equal, instead of, as at present, consisting of 90, 91, 92, and 92 days. From testimony by railway companies, insurance offices, chambers of commerce, and business men, an alteration which would equalise terms would meet with universal approval. It is difficult to see where the trouble mentioned by your contributor would come in. It may be stated that authorities in the leading churches have been consulted, and that apparently no objection would be raised by them. I am informed that the Belgian Foreign Office has addressed a diplomatic inquiry at the Vatican, and that the Holy See is not opposed to the reform of the calendar. Surely the organ of English science is not going to oppose a useful innovation, acceptable to all practical men, which would save an enormous amount of labour in accounting and would simplify all business arrangements. WILLIAM RAMSAY.

University College, Gower Street, London, W.C., February 3.

ALTERATIONS in so fundamental a matter as the regulation of time and of the calendar must always give trouble, and should not be adopted unless very great advantages would result from the change. Now it appears to the writer that no such advantage would be obtained by making the days of the week always correspond to those of the month; indeed, in the arrangements of life it is often found convenient that they should *not* correspond. As to the lengths of the quarters being now unequal, they could be rendered as equal as possible by the simple process of restoring the original regulation of Julius Cæsar, according to which February had 29 days in common years and 30 days in leap-years, and August had only 30 days. Very serious inconvenience would probably result from the ignoring of a day every year, particularly as this would have to be extended to two days in leap-year.

W. T. L.

The Progressive Disclosure of the Entire Atmosphere of the Sun.

SOME of the remarkable spectroheliograms which you reproduce in connection with your report of M. Deslandres' lecture, delivered by that gentleman at the Royal Institution on June 12, 1910, call for special comment. This applies more especially to the pair which represents the sun for March 21, 1910. I had the good fortune to observe spectroscopically an exceptionally fine prominence, which persisted for two entire synodic rotations. During some of the early days in March it graced the west limb, then reappeared in the east about a fortnight later, showed again in the west, reappeared in the east once more towards the middle of April, and gave a final appearance in somewhat modified form on the west limb on April 28. It is fully described and illustrated in an interesting note by Dr. F. Slocum in the *Astrophysical Journal* for September, 1910.

This prominence, while of fair altitude, was more conspicuous with regard to its latitudinal extent. But as regards altitude, it should be mentioned here that the Yerkes photographs were taken in calcium light, while my spectroscopic observations were made in hydrogen Hα light, and I have noted on many occasions, before and

since, that the calcium photographs have a hard, skeleton look about them. In hydrogen Hα the same prominences look more full, and are overlaid by extensive crowns or strata of clouds of varying brilliance, which I cannot find in the corresponding calcium pictures. Thus this prominence also appeared much higher in the radiations of Hα than the calcium spectroheliograms show. In the case under discussion, the prominence was chiefly remarkable by virtue of its enormous extent in latitude, spanning as it did right across the equatorial regions from P.A. 37 to P.A. 84, encircling thus more than 45 degrees of arc practically along an imaginary meredianal line.

It is here where the spectroheliogram taken by M. Deslandres on March 21 comes in, showing as it does this remarkable prominence as a pronounced dark calcium and hydrogen flocculus a few days distant from the east limb. This dark formation conforms in the direction and magnitude of its principal dimensions to the bright structure seen a few days before on the eastern limb. Not only this, but it shows by its pronounced convexity towards the west palpable evidence of equatorial acceleration. Furthermore, it shows along its western contour a bright ribbon, just as one would expect to see if the brighest portion of the prominence was allowed to peep from under an overlying dark or absorbent stratum for reasons of perspective, which in that longitude would be considerable. This is strikingly visible on the glass positives, a fine specimen of which M. Deslandres exhibited at London.

It remains to be recorded as another remarkable feature of this same prominence (by no means infrequently seen by me before and since) that along its top it seemed to be cut off along its entire length by an unbroken and sharp line when seen in Hα, giving the distinct impression that the entire structure was overlaid by a dense, dark, absorbently acting mass of vapours, some other outlines of which under conditions of best definition could be made out, as I pointed out in my recent contribution to solar research in *The Observatory*. The dark flocculus depicted in M. Deslandres' spectroheliogram does in the present case undoubtedly show that hypothetical dark overlying stratum, which therefore is situated at very considerable height above the sun's general surface. The prominence persisted to show this abrupt upper termination during successive appearances, but this was not so apparent when it was last seen in the west on April 28, but even then dark masses were seen projected on the luminous background afforded by the prominence itself.

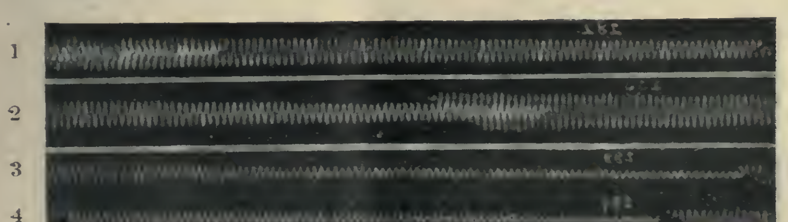
ALBERT ALFRED BUSS.

Chorlton-cum-Hardy, February 16.

Vibrations of a Pianoforte Sound-board.

WHILE investigating the vibrations of the pianoforte sound-board, a curious result was obtained a short time ago which it is perhaps worth while recording.

One leg of an optical lever was attached to the soundboard of a pianoforte at a point 3·5 cm. below the frame supporting the keys and 9 cm. on the treble side of the bridge. A beam of light from an electric arc falls on a concave mirror attached to the optical lever and is reflected to the drum of a phonograph. The combined vibrations of the beam of light, set in motion by the sound-board, and the rotation of the drum trace out a time-displacement curve of the vibration on a strip of photographic film fastened round the drum. For a full description of the apparatus see the *Phil. Mag.* for April, 1910.



Four curves are enclosed. No. 1 was produced by striking the note *a′* on the pianoforte, No. 2 by striking *a* the octave lower. The speed of the drum was the same in both cases, 68 cm. per sec. It will be noticed that No. 2 gives only the second partial of the note struck. This was so unusual that it was thought some mistake had been made, and the apparatus was again connected with the same point of the sound-board. No. 3 shows the curve obtained for *a′* and No. 4 that for *a*, thus confirming the previous results.

It is remarkable that a point can be found on the soundboard which responds so well to the second partial of a particular note that the fundamental is apparently entirely excluded.

G. H. BERRY.

14 City Road, London, E.C., February 3.

Occurrence of *Matonia sarmentosa* in Sarawak.

WHILE resident in Sarawak I received several inquiries with regard to the conditions of growth of *Matonia sarmentosa*, Baker. As I can find no published record of this, the following note will be of interest to pteridophylogists.

It was first found by Dr. Charles Hose hanging from the roof of a limestone cave at Niah, in the Baram Residency, Sarawak; this was supposed to be the only locality in which it occurred, until it was recently discovered by myself to be growing also on the limestones at both Bau and Bidi in Upper Sarawak. Although some 300 miles of jungle separates this district from Niah, there are, I believe, isolated limestone outcrops on which, when careful search is made, it will possibly be found, thus accounting for its erratic distribution, but it has not been found on the limestone at Quop, which has been well searched.

This limestone formation is considered to be Jurassic by Mr. J. S. Gilkie, and is an extremely hard and finegrained type, but as the fern does not grow on the original rock, this can only influence its growth by providing suitable temperature and moisture. In the immediate neighbourhood of these immense masses of limestone a cooler atmosphere is noticeable.

I have never observed this fern growing below 50 feet above the ordinary ground-level; its range may extend to an altitude of 200–300 feet, and then only on the rough and somewhat soft surface of a stalagmite or when the surface of the limestone has received a deposit of calcium carbonate from solution. The position occupied by the clumps is always open and airy; the direct sun rays do not appear to be detrimental, but it is invariably sheltered by an overhanging cliff from the rain. When the conditions are all favourable, it grows in very large masses out of all proportion to its slender root-hold; this renders its detachment from the rock easy, but its inaccessible position makes it one of the most difficult of ferns to collect, and this can only be done by the aid of Dyaks clever at constructing ladders and scaffolding.

It is interesting to note that, of all the ferns peculiar to this limestone, in its choice of situation it is the most highly developed.

CECIL J. BROOKS.

Drinkstone, Bury St. Edmunds.

Glacial Erosion.

YOUR reviewer states that "the passage of ice over the British uplands swept away all the loose rock materials and re-deposited them in the lowlands as glacial drifts." I presume that the *loose rock materials* are supposed to have been produced by pre-glacial *weathering*. Now, weathered rocks are in very many cases easily recognised, and my own experience of the rocks contained in boulder clays is that they very seldom indeed show any signs of weathering whatever. The boulders are of fresh hard rock which has been removed by the ice.

R. M. DEELEY.

Inglewood, Longcroft Avenue,
Harpenden, February 10.

MATERIALS loosened by pre-glacial weathering which are weathered throughout are naturally reduced to powder alike by glacial and by river transport; but any block which is only partly weathered through would loose its weathered crust and the nucleus would be left as a fresh hard boulder.

J. W. G.

THE ETHNOGRAPHY OF SOUTH AFRICA.[1]

MR. McCALL THEAL, the celebrated historian of South Africa, introduced into his volumes on that subject, published first of all some fifteen or more years ago, a variety of chapters and paragraphs on the traditional history, the habits and customs of the South African natives—Bushmen, Hottentots, and Bantu negroes. He considered that this work, owing to its being scattered through a number of volumes was not sufficiently useful or accessible to students of South Africa, and therefore has now selected much of his ethnographical material from the aforesaid history, and has republished it in a separate book, the volume under review. To these chapters originally written, we may suppose, about twenty years ago —or even more—he has added a good deal of recent research work, and it may be said at once that although in some respects this book is not quite up-to-date and fails to appreciate some of the newest theories and most recently discovered facts, it is likely to be essential to all students of Africa for a long time to come. It is eminently readable; and although there are a few mistakes, such as perhaps no such work could be exempt from, the slight defects of the book are rather in the nature of omission than of commission.

Perhaps Mr. McCall Theal's greatest mistake is in connection with the Bushmen and their relationships. He is apt to assume, first, that the Bushmen were the only human race in the Old World, living in a condition of absolute savagery, which at the same time was gifted with a remarkable power of design and an irresistible inclination to make pictures, and to engrave, puncture, scratch, or paint those pictures on rock surfaces. He is therefore inclined to ascribe to Bushmen the marvellously good prehistoric drawings, painting, and engravings which have been discovered during the last fifty years in the caves of France and Spain. But, in the first place, it must be pointed out that the men of the Palæolithic and Neolithic ages who did those drawings have been claimed by other ethnologists as of Eskimo race, simple because the Eskimo, like the Bushman, had the same pictorial gift. Similarly, again, they might be represented as Amerindians or Australoids. It is best to suspend judgment on this subject until we have a far more complete array of evidence. It seems probable that man very early in his history as *Homo sapiens* developed the art of drawing. This art, indeed, is present almost without exception in all savage or uncivilised races at the present day, though in some it remains dormant until a chance circumstance draws it out.

Mr. McCall Theal is also in error when he continues (in spite of all that has been written and published on this subject during the past ten years) to identify the Bushmen with the Congo pigmies, and with other stunted negro races of equatorial or tropical Africa. Dr. F. C. Shrubsall, in reviewing the collections of the present writer, Dr. Arthur Keith, Prof. Duckworth, Dr. Elliot Smith, to say nothing of various German and French anthropologists, have during the past ten years conclusively shown that there was no connection (other than that they were both members of the negro subspecies) between the Bushmen and the Congo pigmies. The last-named are nothing but stunted Forest negroes, whom the peculiar conditions of life in the dense forests have dwarfed. Removed from these unfavourable conditions, the Congo pigmy in the second or third generation grows to a more ordinary stature. Neither in language nor in physique do the Congo pigmies stand apart from the other black negroes.

But the Bushman is a most distinct type of the negro subspecies, due to a divergent development which may be conceivably fifty to a hundred thousand years old. The Hottentot, of course, is nothing but a cross between the black negro and the Bushman.

FIG. 1.—Engraving of a Zebra on a Rock in the District of Vryburg. The original is 13 inches in length. From "The Yellow and Dark-skinned People of Africa, South of the Zambezi."

Mr. Theal descants on the usually hideous aspect, the ultra-negro character of the Bantu Damara (he might have added also, of the Berg-Damara or Haukwoin), but this is likewise a superficial pronouncement. Among the other Herero, and even amongst the Berg-Damara, there are types (some of which the present writer has illustrated through the kindness of the Royal Geographical Society) which might be selected as those of the ideal Bantu, faces almost Hamitic in profile, and even in the abundance and length of head hair. Yet the same tribal designations will cover creatures that might be mistaken for Congo pigmies or the most debased and animal-looking type of Forest negro.

Likewise, amongst the Kafirs and Zulus, the aristocratic types are constantly being given as illustra-

[1] "The Yellow and Dark-skinned People of Africa, South of the Zambezi." A Description of the Bushmen, the Hottentots, and particularly the Bantu, and numerous Folklore Tales of these different People. By Dr. G. McCall Theal. Pp. xvi+397+15 plates. (London: Swan Sonnenschein and Co., Ltd., 1910.) Price 10s. 6d.

tions of the degree of physical beauty to which the negro can attain: yet even amongst these tribes and peoples there are Forest negro types of simian ugliness.

Mr. Theal is conscious himself of the extraordinary mixture of racial types amongst the Bantu, and gives us a vivid picture of their inextricable maze of wanderings in past times. But, of course, all the races of South Africa descended from the north at one time or another. Whether the first arrival of the Bantu-speaking negroes south of the Zambezi was as late in the world's history as Mr. Theal surmises, is a question as to which we cannot arrive at a very precise decision, though he is more likely to be right in his approximate dates than some of his earlier critics. But, of course, it is *inconceivable* that the Bantu invaders, if they came so late in history, found that the southern third of Africa was merely sparsely populated with Bushmen and a few Hottentot hybrids, or the lingering Strandloopers (who may have been more of the forest negro type and are alleged to have preceded the Bushmen). There must have been a fairly abundant negro population in the fertile regions of South-East Africa. To what group or groups did this belong? What language families did they represent? With this again is mixed up the mystery of Zimbabwe. Prof. Randall McIver's researches and criticisms have badly damaged the theory which seemed at one time such a convenient one to explain Zimbabwe and similar ruins: that South-East Africa was colonised perhaps two thousand years ago or earlier, by a foreign, Semitic people—possibly the Arabs of southern Arabia. Prof. von Luschan, of Berlin, has gone into this subject more recently than Prof. McIver, and feels bound to endorse his objections to the art and architecture of Zimbabwe being of extra-African origin. Yet the art and architecture are profoundly unlike anything which has hitherto been developed by the typical Bantu peoples of East or South Africa; and the Makaranga peoples, who are still the principal indigenes of all this region of ruins between the Limpopo and the Zambezi, contain, as Mr. Theal points out quite truly, so many individuals of semi-Caucasian lineaments.

FIG. 2.—Portrait of Herero Men. From "The Yellow and Dark-skinned People of Africa, South of the Zambezi."

Of late, one or two German ethnologists have pointed out the remarkable resemblance between the soapstone birds, and some other emblems of Zimbabwe, and the art of north-western Kamerun, the interior of the Cross River district (see for further light on this the remarkable paper on the Ekoi by Mr. P. A. Talbot in the December number of the *Geographical Magazine*), and even of Benin and Yoruba. The influence of this particular West Africa culture certainly penetrated, athwart all Bantu linguistic influence, down the Congo coast to the mouth of the Congo and to the western parts of the Congo Basin. Can it possibly have traversed Central Africa to reach a great isolated development in the region between the Zambezi and the Transvaal? The physical type of the negroes associated with this Yoruba-Kamerun art is typically negro, but would not differ very markedly in skull formation from that of the average Bantu negro. So far, no skull remains dug up in or near any of these "Zimbabwe" ruins are other than negro of the Bantu type.

Mr. Theal is not able in this book to throw any fresh light on another South African mystery: the place of origin of the Zulus, that is to say, of the dominating tribes or castes in southernmost Africa, which created the present Kafir-Zulu language or group of dialects. Far from this Zulu-Kafir language being what in eariier days was styled by varicus writers the Sanskrit of the Bantu (that is to say, the Bantu language most nearly representing the original mother tongue, and the most archaic in its features), the contrary is the case. Zulu-Kafir is in some respects a widely aberrant member of the Bantu family: the most aberrant, if one exclude from purview certain worn-down forms of speech in the heart of the Congo Basin or the Kamerun. It has probably adopted its three clicks from the Bushmen, but the clicks matter little in comparison with the large proportion of the word-roots which have been—one might think—specially invented and are without any known relationships in other Bantu tongues. The culture of the Zulu recalls strikingly that of the Masai, the most southern in its

range of the Nilotic negro peoples of East Africa. But, so far as I know, not a single Masai, Gala, or Nilotic negro word-root has yet been discovered in the Zulu speech. The main relationships of this very isolated language are with the East African Bantu, though there are strands of West African Bantu in its composition. It has, of course, affinities with the Herero group, and this again is related almost equally to the West African, the East African Bantu, and to the archaic forms of Bantu speech still existing in and about the Victoria and Albert Nyanzas.

Mr. Theal's book has some excellent examples of southern Bantu folklore, though a few of these stories have been so often repeated by other writers (borrowing from him) that they are a little stale. So also are the illustrations, which may be said to have become common property, being derived from early photographs and drawings going back to the 'seventies and even 'fifties. But a very important (and it seems to the reviewer more or less novel) part of the book is that which deals in pp. 264–73, and in chapter xxiv., with the growth in mental development of the South African Bantu and their increase in numbers under a civilised *régime*. On the whole, Mr. Theal's observations would seem to point to a very decided and more or less permanent improvement in mental development and well-being; while as to their increase in numbers under the *Pax Britannica*, there can be no question whatever.

His observations on monogamy *versus* polygamy would seem—whether he intends it or not—to bear out in a moderate way the opinions of various missionaries and students of Africa, that under monogamy the rate of increase is at least as great as that which prevails under the conditions of polygamy, and perhaps is greater; while the improvement in morals and the well-being and bringing up of children under the system of "one husband, one wife," can no longer be disputed.

H. H. JOHNSTON.

PHOTOGRAPHIC BIOGRAPHY OF BIRDS.[1]

THE present volume is a companion to the "Home Life of a Golden Eagle," noticed in NATURE of May 26, 1910. It is about the same size, but four biographies instead of one are contained in it. The "Home Life of a Golden Eagle" as a *vie intime* will be difficult to excel. It admitted us, by means of that impersonal spy, the camera, to the closest intimacy with the entire domestic arrangements, and to the unbroken succession of parental duties of the royal birds. Mr. Beetham has attempted to do for the spoonbill, the white stork, and the common and the purple herons, what Mr. Macpherson did for the eagle. We have to confess with regret that he has succeeded only *multum post intervallum*. Both watchers employed from an ambush the same methods of the masked camera; but we have from Mr. Beetham fuller details of the methods than of the object for which they were the end. Both were experts in picture-taking, and our author's results are in no way inferior to those of Mr. Macpherson. The methods they employed are, it seems to us, those by which the accurate life-histories of our birds up to the standard of that of the golden eagle can be obtained. It will take a long time before they can all be biographed, but it will eventually be accomplished so long as among the photo-ornithologists are to be numbered men like Mr. Beetham, who despise the unnumbered difficulties, discomforts, and often very real dangers necessary to securing unimpeachable records.

[1] "The Home-life of the Spoonbill, the Stork, and Some Herons." Photographed and Described by B. Beetham. Pp. viii+47+32 mounted plates. (London: Witherby and Co., 1910.) Price 5s. net.

To be of real value, however, the observations must be a continuous series of the same subject taken at carefully chosen intervals, accompanied by detailed descriptions of careful personal observations. In this respect the present budget of biographies leaves much to be desired. Instead of a connected diary we have disconnected glimpses into the different households through swings of the door. The "Home Life of a Spoonbill" can hardly be called more than a passing "look in" at the nursery. Yet the peeps we do get are not without value, and many are very interesting, but they are solitary episodes in the bird's history. Plates i. and ii. refer to one home; there its story ends. The remaining nine are pictures of another home. Plate iii. was photographed on June 17, iv. and v. on June 19, and the remaining six on June 23. We are introduced to the young spoonbills when they are ten days old; we next re-visit their home

FIG. 1.—The claw of each toe has a strong hooking action. From "The Home-life of the Spoonbill," by Bentley Beetham.

when their age is twelve and fifteen days respectively, when this second biography—which had no beginning—also ends.

This is a very great contrast to the absorbingly interesting development of the golden eagle's nestling in unbroken sequence, from its birth to its coming of age. Not more satisfying is the record of the white stork, which begins when the storklings are fully fledged, and though we have eight very excellent photographs of them, we learn nothing about their plumage changes and little about their upbringing and education by their parents. We are equally disappointed with what can hardly be called the "home-life" of the common and the purple herons. We are brought on the scene when the first chick of the former emerges on April 11; then the door is closed for six weeks—the most interesting period of the

babe's life—to re-open on the final scene, when the nestlings are ready to escape, and really do so on the approach of the observer.

The story of the purple heron contains many interesting observations on the habits of the half-fledglings, which we believe to be, if not new, at least not widely known. It seems that during the intervals between their meals they descend from the nest and disport themselves on the ground, to re-occupy it when the mother is heard approaching. Usually when a nestling leaves its nest it is difficult if not impossible to induce it to remain in it, even if replaced. Although the promise of its title-page is hardly fulfilled, the book is interestingly written, and will be read through when once taken up. As a photographer, Mr. Beetham has been most successful, and his pictures (two of which, by the courtesy of the publishers, we reproduce here) have a high value independently of their use as illustrations to his present book, which seems to be produced at an astonishingly low price.

FIG. 2.—A Bittern-like attitude, with the bill held vertically. From "The Home-life of the Spoonbill," by Bentley Beetham.

THE CONSERVATION OF NATURAL RESOURCES.[1]

THE two men who have played the largest part in the conservation movement that has now assumed such great importance in the United States are probably Gifford Pinchot and President Roosevelt. Pinchot was primarily responsible for the forests, but he saw that the conservation of forests could not be dealt with satisfactorily by itself, but was intimately bound up with the conservation of water, of the soil, and of mineral resources. It was this flash of genius that founded a new branch of economics, and the strong personality of the President brought the subject at once into the region of practical politics.

In the volume by Mr. Van Hise, which contains the substance of lectures given at the University of Wisconsin, he traces the history of the famous conference held in the East Room of the White House on May 13, 1908. For the first time in the history of the country the governors of the various States were called together to consider a national question. The President's letter of invitation, and the declaration passed, are both recorded in the second book on our list, and are both weighty documents, worthy of a great occasion. The first outcome has been to take an inventory of the natural resources. The second, and much more difficult, has been to start a great educational campaign to bring home to the individual citizen his responsibility in the matter, and to point the way of reform.

The report of the Conservation Commission of Maryland deals with the mineral resources, soils, forests, waters, fisheries and oysters, game, scenery, public health, and roads, thus giving a more complete picture of the State than has hitherto been available in any one volume. The account of the mineral resources resembles in a general way our own geological survey memoirs, and the treatment of the other subjects is not dissimilar. Mr. Van Hise's book may be regarded as representative of the educational outcome of the movement. He discusses the minerals, forests, soils, and waters, and finally proceeds with a series of recommendations calculated to carry out the objects of the conservation movement.

Dealing first with the mineral resources, it is pointed out that they are far greater than those of any other nation, and they bring in some $2,000,000,000 per annum, an amount only exceeded by the returns from agriculture. Coal is by much the most important, but it is being mined at an astonishing rate; in 1846 only five million tons were

1 "The Conservation of Natural Resources in the United States." By Charles R. Van Hise. Pp. xv+413. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 8s. 6d. net.

"Report of the Conservation Commission of Maryland for 1908–9." Pp. 204. (Maryland, Baltimore, 1909.)

raised, while in 1907 more than 480 million tons were got. The consumption per head of population rose twentyfold during this period. If this rate of increase of exploitation went on the whole coal supply would be exhausted in 150 years, but reasons are adduced against so short a life. The exact period is unimportant. "So far as our responsibility is concerned," says the author, "it is immaterial whether the coal will be exhausted in 150 years, 1500 years, or 15,000 years. Our responsibility to succeeding generations demands that we reduce its use to our absolute necessities, and therefore prolong its life to the utmost." The waste in mining must be reduced; it varies from 50 to 150 per cent. of the total amount sold, and is often irrevocable. Many thousands of tons of slack are thrown out and burnt in heaps simply to get rid of it. The beehive coke ovens, of which there are said to be some 95,000 in the States, are declared to waste fully $50,000,000 worth of material every year in comparison with the more modern types that might be introduced. Mechanical stoking effects a great economy. Finally, there is the waste owing to imperfect combustion, neglect of waste heat, and so on. Cheaper substitutes might often be got; gas engines are more economical than steam engines, while great improvements are possible in lighting. Two lines of reform are suggested: an educational campaign, and legislation to control mining rights and to make waste an offence.

The increase in the output of petroleum has been enormous. During the first nine years of this century more than 1,155 million barrels of 42 gallons was got, this being more than 50 per cent. of the *entire output* since it was first taken from the ground. If the present annual output continues it is estimated that the supply will give out in about ninety years. Much of the oil is exported, and a fair proportion is used for power. It is suggested that exportation should be forbidden, and the home consumption should be restricted to lubrication and lighting. About natural gas the author has some very strong things to say; the waste, he tells us, has been appalling. Gas has often been tapped when oil was sought; instead of closing up the bores or utilising the gas the wells were lighted and allowed to burn. "In some cases a well has been thus allowed to burn for twenty years. . . . Some of the wells have been allowed to burn until the rock has caved in so extensively as to have become veritable flaming lakes. It is estimated that in the Saddo field alone of Louisiana some 70,000,000 cubic feet per day of gas are wasted, burned without doing any good in any way to anybody." Legislation to stop the waste never gets through; attempts are regularly made, but "some unseen power greater than Governor or Legislature has so far thwarted and palsied every effort."

Turning now to iron ore, most of this occurs in the region of Lake Superior, and at least half is in the hands of one corporation. If the rate of exploitation during the three past decades is maintained the high-grade ores will be exhausted in about three decades more. But the author has no special anxiety for the future; the ore is handled economically, low-grade ores not yet profitable are stored instead of being wasted, new deposits will probably be found as the survey becomes more complete, and stone and cement are being used in place of iron.

With water the principles of conservation are different. So vast a quantity of water falls on to the land every year that absolute exhaustion is out of the question; what is needed is to utilise the supply more fully. Water that has been used for domestic purposes may be used for irrigation with great advantage, as it now contains fertilising material. Water used for power may later be used for domestic purposes, for navigation, or for irrigation. At present, however, there is an actual exhaustion of the water supply. In some parts of the States the level of the underground water has fallen ten to forty feet. We ourselves are in a similar situation; the water level in the chalk round London is known to be falling, and great drafts are being made on the water in the lower strata.

The original forests of the United States are estimated to have covered some 1000 million acres, of which one-half has gone. The amount of wood used is enormous, but so great is the waste that only three-eighths of what is cut appears in the final product. Loss by forest fires is appalling. "Boxing" the trees, *i.e.* cutting cavities in them for the purpose of collecting turpentine, kills many of them. It is estimated that the average growth on the forest land is 12 cubic feet per annum per acre, while the amount taken is 40. The waste of timber is attributed at least in part to the feeling that the natural resources were illimitable, and could never in any circumstances give out.

Lastly, the author deals with the conservation of the soil. First of all, there is the trouble due to land speculation, which no legislation has ever been able to get over. Then there is the question of improper cropping. No "one crop" system can last without an adequate expenditure on manure, and whether the one crop has been cotton, as in the south, or wheat, as in parts of the north, the result in the end is disastrous unless proper manure is added. Now all experience is that sufficient manure is not added, and so we find in parts of the States that most terrible of all sights—derelict land. Spillman considers that in more than half of the area of the States the fertility of the soil has fallen. Recourse has been had in the dry regions to irrigation, with the inevitable result that trouble has arisen through "alkali," *i.e.* an accumulation of salts in the soil to such an extent that the plant suffers. Methods of control are slowly being worked out, but for a long time to come difficulties will arise from this source.

Depletion of soil nitrogen is serious, but not beyond remedy; thanks to the work of Sir William Crookes and others nitrogenous manures are now being made from atmospheric nitrogen. Depletion of soil potassium compounds is also serious, but again, is not beyond remedy. The disquieting feature is the depletion of the phosphates. Every year this goes on; whatever the crop and whatever the treatment a certain amount of phosphate is taken up and sold off. Phosphatic manures are required and are being used at an enormous rate. Fresh deposits are being made by birds on the guano islands off Peru, but how are the birds treated? Coker in 1908, in his report to the Peru Government, speaks of "the robbery of eggs on a large scale in past years, the destruction of young and old birds, and the disturbance of the birds in their nesting grounds by the extraction of guano." We are not surprised when he goes on to say that there "has been a great diminution in number."

Some of Mr. Von Hise's data may be wrong—he always gives his references—but it is incontrovertible that we are taking but little thought for the morrow. No doubt we in Great Britain have not wasted natural gas, but what about our coal? Who can defend our Victorian grates—still much the commonest form, in spite of better types recently introduced—and our utter neglect of waste heat in our houses? There is no evidence that our soils are becoming exhausted; much of the land is left in poor pasture, and gives us little return, but at least it is storing up fertility for a future generation. But then we are importing enormous quantities of foodstuffs from abroad, some of which, being fed to cattle, helps to fertilise the

land, and we also import much manure. Our great waste in this direction is our failure to recover the fertilising material from sewage; at present this may be unavoidable, but there are other wastages—loss of manures from our farms—that might be remedied. We are far from blameless in the matter of forestry also. The conservation movement is attracting attention in Canada, and it will, let us hope, become a power there and also in the other dominions beyond the seas. First of all, however, the great educational crusade must come to impress upon the present generation that our patrimony is not to be squandered but to be used wisely, and handed on to our descendants in as good a condition as possible.

E. J. R.

INDIAN WHEAT FOR THE BRITISH MARKET.[1]

THE last seven years have seen a rapid development of the Indian wheat trade with the United Kingdom. For the ten years ending 1902, when our average annual import of wheat and flour was 99 million cwt. from all countries, we received an average of 5 million cwt. from India; for the past seven years, however, our total import has been 114 million cwt. on the average, of which 16 million cwt. have come from India. The increase is due to several causes. Cultivation and irrigation have extended in India; the seasons in the northern provinces have, on the whole, been more favourable since 1903 than they were in the eight years following 1894; there has been a great improvement in the means of communication by ship, railway, and road, and, finally, the rupee has been maintained at the uniform rate of sixteenpence since 1898. For the past seven years the area sown with wheat in India has been more than 26 million acres, or about one-ninth of the world's wheat area (estimated at 240 million acres), and the average yield has been 11·6 bushels, one-eleventh only of the world's output, since this yield is lower than in many other countries. It is chiefly in the Punjab that the increase has taken place, and, as larger areas come under irrigation, this province will assume more and more importance as a producer of the world's food.

Great Britain takes more than 90 per cent. of the Indian exports of wheat, and the conditions obtaining in our markets have therefore to be studied seriously by the Indian producer, or rather by his expert adviser. At present Indian wheat does not come here in the beautifully clean, well-graded state in which Canadian wheat arrives, and it therefore commands a shilling a quarter less price. It is, however, more valuable than English wheat, and usually fetches about 2*s.* 6*d.* a quarter more, chiefly on account of its lower moisture content. The reason for its inferior condition is to be found partly in the circumstances in which the wheat is grown; most of the Indian wheat is grown on small peasant's holdings, and is threshed by being trodden out by bullocks on an earthen threshing-floor, and winnowed by hand in the wind, so that there is some mixing of varieties and a certain amount of dirt naturally gets in. Sir James Wilson states, however, that the wheat as it leaves the farm contains only about 1 per cent. of dirt, whereas when it reaches London the various handlers have contrived to dilute it 6 per cent., so as to increase their profits. It is considered that a revision of the terms of contract would get over this difficulty. The other questions—the mixing of varieties, and the low average yield—are matters for the experiment stations, but it seems probable that they can be satisfactorily dealt with.

[1] Memorandum on Indian Wheat for the British Market. By Sir James Wilson, K.C.S.I., late Financial Commissioner, Punjab. (Agricultural Research Institute, Pusa.)

NOTES.

THE portrait of Sir William Crookes by Mr. E. A. Walton, to which reference was made in our issue of February 9 (p. 481), was presented to the Royal Society before the ordinary meeting on Thursday last, February 16. In the absence of the treasurer of the fund, Lord Avebury, the presentation was made on behalf of the subscribers by Prof. Meldola, who acknowledged the active cooperation of his colleague, Prof. Pope. The necessary fund was contributed by about 130 Fellows of the society. Sir Archibald Geikie, as president, accepted the portrait on behalf of the society in a graceful speech. Sir William Crookes also expressed his thanks to the subscribers for the honour they had conferred upon him. In the course of his remarks he said that in two years he hoped to celebrate the jubilee of his fellowship, as his election dated from 1863.

SIR JOSEPH LARMOR, secretary of the Royal Society, has been elected a member of Parliament to represent the University of Cambridge, in the seat rendered vacant by the death of Mr. S. H. Butcher. Sir Joseph is Lucasian professor of mathematics in the University, and his election as one of its two parliamentary representatives places in the House of Commons a man of distinguished eminence who should command attention in that assembly, and be able to do something for the development of scientific method in national affairs.

H.R.H. THE DUKE OF CONNAUGHT has been elected president of the Royal Society of Arts.

The British Medical Journal announces that the Fothergillian gold medal of the Medical Society of London, given triennially, has been awarded to Dr. F. W. Mott, F.R.S., for his researches on the nervous system.

AT a meeting of the executive committee of the British Science Guild, held on February 15, it was agreed that the Guild and the British Empire League should dine together, and it is hoped that it may be possible to entertain the Colonial Premiers when they are over for the conference. It was also reported that the Guild's committee on the coordination of charitable effort was in communication with the Social Welfare Association for London to see if it might not be possible for them to work together.

DR. J. C. BRANNER, professor of geology at the Leland Stanford Junior University, California, is starting on April 15, with six assistants, on an expedition to explore the western part of the north coast of Brazil. Its special object will be to determine how far the distribution of Brazilian fauna is affected by the obstruction of the Amazon River. The Government of Brazil has offered the explorers the use of a gunboat.

DR. EDWARD G. JANEWAY, one of the foremost diagnosticians in the United States, died at Summit, New Jersey, on February 10, in his seventieth year. At Bellevue Hospital Medical College, New York, he was professor of pathology and practical anatomy from 1872 to 1879, professor of diseases of the mind and nervous system from 1881 to 1886, and professor of medicine from 1886 to 1892. From 1898 to 1905 he held the chair of medicine at the medical school of New York University. He was health commissioner of New York City from 1875 to 1882.

THE recent death-roll in America includes the name of Dr. Leonard Parker Kinnicutt. He was born in 1854, and spent his student period at the Massachusetts Institute of Technology, the Universities of Heidelberg and Bonn, and Johns Hopkins University, Baltimore. He held a

junior post at Harvard from 1880 to 1883, since which year he had been connected with the Worcester Polytechnic Institute as assistant-professor and professor of chemistry successively. His chief work was done as an expert on sewage disposal and water supply, and he had acted as consulting chemist to the Connecticut Sewage Commission.

The Times announces the death of Dr. C. Alexander MacMunn, of Wolverhampton, at fifty-nine years of age. Dr. MacMunn was a member of the Physiological Society, the Marine Biological Association, and other bodies, and he devoted himself largely to research, mostly in physiological chemistry and animal pigments. He published numerous works, some of which were translated into foreign languages, and at the time of his death was engaged on "Outlines of Clinical Chemistry," which was nearing completion.

The death of Dr. William Williams, an authority on sanitation, is announced in *The Times*. Dr. Williams was president of the Sanitary Inspection Association of South Wales and Monmouthshire, and held public appointments in Glamorgan, including that of school medical officer and director of the County Public Health Laboratory. He was a Fellow of the Society of Medical Officers of Health and the Royal Sanitary Institute, and ex-president of the South Wales branch of the British Medical Association. He delivered the Milroy lectures at the Royal College of Physicians in 1904. He wrote works on sanitation, water supplies, and milk adulteration.

In pursuance of the powers conferred on them under a section of the Development and Road Improvement Funds Act, 1909, the Development Commissioners have appointed an advisory committee to advise them on applications for advances and schemes for the development and improvement of fisheries. The committee is constituted as follows:—Mr. H. J. Tennant, M.P. (chairman); Dr. A. E. Shipley, F.R.S.; Prof. G. C. Bourne, F.R.S.; Prof. D'Arcy Thompson, C.B.; and Mr. D. H. Lane, formerly Inspector of Irish Fisheries. In addition, the Fishmongers' Company has been asked to nominate a representatie.

On Tuesday next, February 28, Dr. A. E. H. Tutton will begin a course of three lectures at the Royal Institution on "Crystalline Structure: Mineral, Chemical, and Liquid," and on Saturday, March 4, Sir J. J. Thomson will commence his course of six lectures on "Radiant Energy and Matter." The Friday evening discourse on March 3 will be delivered by Dr. F. A. Dixey, on "Scents of Butterflies"; on March 10 by the Hon. Charles A. Parsons, on "Recent Advances in Turbines"; and on March 17 by Mr. John H. Balfour Browne, on "Water Supply."

Sir William H. White, K.C.B., F.R.S., has been awarded the John Fritz medal for 1911, for "notable achievements in naval architecture," by the special board of award appointed by the four leading American societies of engineers—the Civil, Mining, Mechanical, and Electrical. The John Fritz medal is recognised as the highest distinction which American engineers can bestow. It was established in August, 1902, by the professional associates and friends of the engineer and metallurgist whose name it bears. The award of the medal is made on the ground of "notable scientific or industrial achievement," with "no restriction on account of nationality or sex." The first award was made in 1905 to Lord Kelvin. In subsequent years the medal has been given to Alexander Graham Bell, Thomas A. Edison, George Westinghouse, Charles Porter, and Alfred Noble.

The anniversary meeting of the Geological Society of London was held on Friday, February 17. The officers were appointed as follows:—*President*, Prof. W. W. Watts, F.R.S.; *vice-presidents*, Dr. C. W. Andrews, F.R.S., Mr. Alfred Harker, F.R.S., Dr. J. E. Marr, F.R.S., Prof. W. J. Sollas, F.R.S.; *secretaries*, Prof. E. J. Garwood and Dr. A. Smith Woodward, F.R.S.; *foreign secretary*, Sir Archibald Geikie, K.C.B., president R.S.; *treasurer*, Dr. A. Strahan, F.R.S. The following awards of medals and funds were made:—Wollaston medal, Prof. Waldemar C. Brögger; Murchison medal, Mr. R. H. Tiddeman; Lyell medals, Dr. F. A. Bather and Dr. A. W. Rowe; Bigsby medal, Prof. O. Abel; Wollaston fund, Prof. O. T. Jones; Murchison fund, Mr. E. S. Cobbold; Lyell fund, Dr. C. G. Cullis; Barlow-Jameson fund, Mr. J. F. N. Green. The president delivered his anniversary address, which dealt with the evolutionary aspects of geology, more especially with the mode and order of deposition of the various formations.

An International Congress of the Applications of Electricity is to be held in Turin, Italy, on September 9–20. This congress, as its title implies, will deal with questions of practical import, so that electrical engineers will be able to participate largely in the discussions. The chief endeavour of the organising committee, which is under the chairmanship of Prof. Luigi Lombardi, has been so to draw up the programme that the congress may be international in character as well as in name. To attain this object, the cooperation of the International Electrotechnical Commission, with its local committees now established in many countries, has been obtained, as well as the assistance of the societies and associations in all countries dealing with electrical matters. With the help of these organisations, official reporters have been selected, and already many assurances have been received that numerous papers will be presented to the congress from all parts of the world. The initiators of the congress are the Italian Electrotechnical Society and the Italian local committee of the commission mentioned above. The congress is under the patronage of H.R.H. the Duke of the Abruzzi, who is the president of the committee of honour, upon which Prof. Elihu Thomson and Colonel Crompton, the president and honorary secretary respectively of the commission, have been elected members. Papers are to be presented in French, English, German, and Italian, and the discussions will be carried on in all these languages. The subjects to be discussed, the attractions which Italy itself presents, both as regards scenery and electrical development, in addition to the fact that the first official meeting of the whole Electrotechnical Commission is to take place in Turin about the same time, is bound to make this congress a memorable occasion in the history of electrical engineering.

We regret to record the death, on February 8, of Mr. P. D. Scott-Moncrieff, assistant in the Department of Egyptian and Assyrian Antiquities in the British Museum. The cause of death was heart failure, after an operation for appendicitis. Mr. Scott-Moncrieff was educated at Charterhouse School, at St. Andrews University, and at Christ's College, Cambridge. At Cambridge he took the Oriental languages tripos, and in December, 1903, he was appointed to an assistantship in the British Museum. His official duties brought him in contact chiefly with the Egyptian side of his department, and in the winter of 1905 he paid a visit to the Sudan to undertake archæological work for the Sudan Government. In October and November of that year, in conjunction with Mr. J. W. Crowfoot, he cleared out the eighteenth dynasty temple

at Wady Halfa, of which he afterwards published an account, with plan and photographs, in the Proceedings of the Society of Biblical Archæology. After finishing his work on the temple, he assisted in arranging the monuments in the newly-founded Egyptian Museum at Khartum. As a result of his work at the British Museum, Mr. Scott-Moncrieff had completed the first part of an official publication of hieroglyphic texts from Egyptian stelæ, which it is hoped will shortly appear. He had devoted considerable study to the archæology of the later periods of Egyptian history, and, as first-fruits of his work, he contributed a critical discussion of Plutarch's treatise "De Iside et Osiride" to the *Journal of Hellenic Studies*. For several years past he was also engaged on an examination of the problems presented by the early developments of Christianity in Egypt. He approached the subject from the archæological side, and, at the time of his death, he had nearly completed the MS. of a volume which he proposed to call "Paganism and Christianity in Egypt." His friends hope that arrangements will be made for the publication of this work in the manner and form which he desired.

THE Maya hieroglyphs still await complete decipherment. Some progress towards their interpretation has recently been made by Mr. W. E. Gates, who describes his methods in part i., vol. vi., of the archæological and ethnological publications of the Peabody Museum. The famous Perez Codex, accidentally discovered about fifty years ago in the Bibliothèque Impériale, Paris, has been reproduced by Prof. de Rosny. But these facsimiles are scarce, expensive, and not easily accessible to students. Mr. Gates has now succeeded in reproducing the hieroglyphs in a form of type, of which examples are given in his paper, and has thus greatly facilitated the study of this obscure series of pictorial documents.

IN his treatise on the people of Hungary, "Ethnographie von Hungarn," published in 1877, Paul Hunfalvy describes a race known as the Ishmaelites, whom he identifies with the Mohammedans. Mr. Leo Wiener, in an article in the number of the *Gypsy Lore Journal* for last October, reviewing the original authorities on which Hunfalvy relied, shows that there is much to be said against this identification. He comes to the conclusion that these people were gypsies, the original name Ishmaelite becoming merged with Saracen, and the latter in its turn giving way to the more popular appellation Cigan, which, by the beginning of the fifteenth century in southern Europe, completely overshadows every other designation of the gypsy race.

THE possibilities of the Tuantepec Isthmus as a rival to Panama are seriously engaging the attention of American geographers. The character of the country, its people, and resources are described in a well-illustrated article, by Miss H. Olsson-Seffer, in the December (1910) issue of the *National Geographic Magazine*. The native Indian tribes are a singularly fine race, and the beauty of their women, dress, and ornaments is remarkable. As the Tuantepec route reduces the distance, as compared with that *via* Panama, to Honolulu by 1273 miles, it may become a serious competitor for traffic between the Atlantic and Pacific Oceans.

To the current number of *Scientia* Signor Rignano contributes an article (in French) on "The Mnemonic Origin and Nature of the Affective Tendencies." The author points out that in every living organism there are physiological systems in a state of rest, which it is always tending to maintain or, when disturbed, to return to. He cites various biological instances showing that, when an organism adapts itself to a changed environment, the altered conditions at once tend to become the "optimum" for that organism. Thus he deduces a basis of memory, a mnemonic origin, for every such optimum, to attain which the organism is always reacting, and subjectively experiences an affective tendency of want, appetite, or desire.

IN the third part of "Zur historischen Biologie der Krankheitserreger," published at Giessen in 1910, Prof. G. Elliot Smith and Dr. M. Armand Ruffer give an account of Pott's disease of the spine in an Egyptian mummy belonging to the time of the twenty-first dynasty about 1000 B.C. The paper is illustrated with two plates, showing a drawing and a photograph of the angular curve of the spine as seen from without and from within the body. The authors claim no novelty in the discovery of a case of Pott's disease in the remains of the ancient Egyptians. They believe it of importance, however, as being the first case which has been thoroughly investigated and proved to be tuberculous in nature, and their case has led to the detection of tubercle as the cause of abnormal conditions found in other bodies since examined. Many ancient Egyptian bodies have shown abnormal curvature of the spine, and some of these have been described as instances of Pott's disease. On examination, however, they have been found to be in reality typical examples of osteo-arthritis, or the disease described and illustrated by Dr. Wood Jones under the name of "spondylitis deformans." This disease was extremely widespread in upper Egypt, particularly in the predynastic age, so much so that signs of it are to be seen in practically every body raised from a common burial ground of that time. This disease was also widespread in the time of the Persian dynasties, about 525–332 B.C., and in lower Egypt the skeletons of Macedonian soldiers and their families frequently show unmistakable signs of spondylitis deformans. The mummy described by the present authors shows a very typical angular curvature of the spine, while the interior of the body shows the remains of a psoas abscess, a very frequent complication of tuberculous disease of the spine at the present day.

AN illustrated account, by Mr. W. H. Mullens, of the two Tradescants and the famous Tradescant Museum—which once contained the whole skin of a dodo—forms the first article in Witherby's *British Birds* for February.

VOL. vii., No. 2, of the Zoological Publications of the University of California is devoted to an account of the birds and mammals collected during the Alexander expedition to Alaska in 1909, two rodents being described as new.

THE fifteenth instalment of the report on the zoological results of Dr. Franz Werner's expedition to the Egyptian Sudan and northern Uganda in 1904 appears in vol. cxix., part vi., of *Sitzber. Acad. Wissenschaften*, Vienna. In this contribution Dr. E. von Daday commences an account of the microfauna of the Nile and its tributaries, as exemplified by plankton collected by the traveller at a large number of localities, but actually deals only with the Egyptian forms. Many of these have been previously identified in other parts of Africa, but half-a-dozen crustaceans are described as new.

THE Biological Survey Division of the U.S. Department of Agriculture has issued (as Bulletin No. 36) an illustrated pamphlet on the practicability and possibilities of breeding deer and other big game in confinement in the United States in such a manner as would make the experiment

remunerative. The author, Mr. D. E. Lantz, states that, were it not for prohibitive laws, there would be a large and constant demand for venison in the country, and that it could be placed on the market at a lower price than beef, owing to the facility with which deer can make a living on poor pasture. Both the wapiti and the white-tailed deer are rapidly diminishing in numbers, and since both kinds can be easily tamed and bred in confinement, there is every inducement for trying the experiment, which, if successful, would prove a lasting benefit. For a time, the rearing of both species for stocking parks ought to be more profitable than the sale of the venison. Schemes for domesticating the caribou and the moose as beasts of draught, as well as for introducing Indian and African antelopes into the United States, are likewise mooted.

The Journal of the College of Science of the Imperial University of Tokio (vol. xxvii., article 17) contains an interesting account by N. Yatsu of his experiments on germinal localisation in the egg of Cerebratulus. These experiments afford a typical illustration of the manner in which experimental methods are now being applied to the study of animal development. Ovisection in various planes, and separation or dislocation of the blastomeres by mechanical or chemical means are employed, and though the results obtained cannot, perhaps, be regarded as very definite, they are certainly very suggestive. The author concludes that the egg contains "organ bases," but that these have no hard and fast lines of boundary between them; still, there is "something" for each larval organ. He also concludes that there must be a regulating "factor" which in some way brings back shifted blastomeres to the normal position, or, at any rate, to such a position that they are able to produce a larva which differs but little from the normal.

The problem of sex-determination is just now receiving a good deal of attention from students of heredity, and an interesting controversy has arisen with regard to the Mendelian interpretation of sex ratios. Russo maintains that he is able to alter the proportion of the sexes in the case of rabbits by injecting lecithin into the female parent before the eggs have arrived at maturity. Two kinds of eggs are said to occur in the ovary, one of an anabolic or constructive type, containing globules of lecithin, and the other of a katabolic type, containing crystals of acid fat. The former are believed to give rise to females and the latter to males, and the injection of lecithin into the parent increases the proportion of females. Russo's results have been criticised by Punnett, and more recently by Castle (*American Naturalist*, July, 1910), and Russo replies in the *Biologisches Centralblatt* (January 1, 1911). He points out that Punnett, in repeating the experiment, only administered the lecithin by the mouth of the rabbit, instead of by injection, and that it is decomposed in the alimentary canal. It is obviously very important that Russo's experiments should be repeated by an impartial observer, and that the methods employed by him should be strictly followed.

A catalogue of botanical books, chiefly secondhand, comprising floras of all countries, has been recently published by Messrs. John Wheldon and Co., Great Queen Street, London. The fullest sections are those enumerating general and local British floras, and systematic publications dealing with the plants of India, North and South America, and Australasia.

The fifth number of last year's botanical volume of the *Philippine Journal of Science* contains the conclusion of the article, by Mr. E. D. Merrill and Mr. M. L. Merritt, on the flora of Mt. Pulog, and a revision of the Philippine Piperaceæ, by Dr. C. de Candolle. The latter paper raises the total number of Piperaceæ known to exist in the Philippines from thirty to one hundred and twenty-five, all referable to the two genera Piper and Peperomia.

Two articles on the subject of pansies and violas, published in the Journal of the Royal Horticultural Society (vol. xxxvi., part ii.), cannot fail to interest growers, as they are contributed by Mr. J. Grieve and Mr. Wm. Cuthbertson, experts of many years' standing. Mr. Grieve explains that he originated his violas by applying pollen from "show pansies" to the stigma of wild species, *V. lutea*, *V. cornuta*, *V. stricta*, and *V. amoena*; the reverse cross did not give any good results. Hints on culture are supplied by Mr. Cuthbertson, who remarks that many of the best varieties raised years ago still continue to maintain their position.

Some historical notes, compiled by Mr. H. B. Watt, with reference to early tree planting in Scotland appear in the *Glasgow Naturalist* (vol. iii., No. 1). The introduction of fruit-bearing trees during the period of Roman occupation, and plantations round monasteries and ecclesiastical establishments, are suggested as the earliest beginnings. Historical references date from the fifteenth century, and the first plantations at Inveraray appear to have been about the year 1600. Evidence for computing the ages of the oldest trees, chestnuts, sycamores, and beeches, is presented; the Kippenross sycamore and Corstorphine "plane" are referred to the fifteenth century. A list of trees enumerates twenty native and fifty introduced species.

In many countries at the present time the detailed investigation of their geographical conditions attracts as much attention as the study of distant lands, and has the advantage of being based on much fuller and more accurate information; moreover, the period over which such data are spread enables comparisons to be made between the conditions which existed at different periods. In the December (1910) number of *Petermann's Mitteilungen* Prof. H. Hassinger presents a brief study of the geography of towns and cities, indicating in a systematic manner the lines of investigation which may be followed in order to show the influence that their surrounding and the requirements of the population have had on their development. Dr. Maull in the same number discusses a more localised subject, the zone of the northern limestone Alps, and traces the settlements and lines of communication as they occur in forest belt and neighbouring region, as well as their gradual development. A more specialised type of study is that of Dr. K. Schneider (*Mitt. k.k. Geog. Gesell. Wien*, Nos. 11, 12, 1910), wherein he discusses at some length the geographical relations of the German and Czech peoples in Bohemia, the development of towns and cities, communications, and commercial intercourse.

The meteorology of the future is the subject of an instructive lecture delivered some time since by Prof. C. Abbe at Columbia University, and printed in the *Popular Science Monthly* for January. The author admits that the question is a very difficult one, and that it is impossible to foresee in detail the problems of the future. Long ago mariners took advantage of the knowledge of trade winds and monsoons, but it took two more centuries to acquire a knowledge of whirlwinds as they advance over the globe, and we are not yet able to speak of weather forecasts as more than probabilities. Some very interesting experiments were arranged, illustrating the formation of cloud and rain, and, with reference to ineffectual attempts made in some countries, it was shown that if we wish to avert

rain or hail, we must be able to cut off the supply of moisture, or prevent rapid expansion. The most important problem at the present time, and in future, will be to attain a clear idea of the mechanics of the atmosphere as a whole, comprised under the technical terms hydromechanics, aëro- and thermo-dynamics, and another century may elapse before all these questions can be solved. When meteorology has become more truly deductive, the author further remarks, then we can pass to the satisfactory discussion of the great problems that we now can merely toy with.

In an address delivered on December 29, 1910, as retiring vice-president of Section B (Physics) of the American Association for the Advancement of Science, Dr. L. A. Bauer deals with some problems of terrestrial magnetism, especially with the question whether the sudden commencements of magnetic storms are simultaneous in occurrence at different places. The views which he expresses on this subject are similar to those already given by him in Nature. Dr. Bauer also refers to a different type of storm having effects appreciable over only limited areas, but does not say explicitly whether the type is essentially different from the "polar elementary" storms described by Prof. Birkeland in the Arctic or the "special type of disturbance" recorded in 1902–3 in the Antarctic. Towards the end of his address, Dr. Bauer states that modern researches point to the conclusion that attempts to represent the earth's magnetic field by a Gaussian potential are of doubtful value, owing to the enormous number of Gaussian constants required to represent anything beyond the more general features.

The annual report of the council of the Institution of Mechanical Engineers for the year 1910, which was adopted at the general meeting on February 17, deals with the chief directions of the progress and work of the institution. The work of the alloys research committee has been continued at the National Physical Laboratory, and it is expected that the tenth report will be presented for discussion during the current session. It will deal with the binary system of alloys of aluminium-zinc, together with some preliminary results obtained in a ternary system of aluminium-zinc-copper, the quantity of copper being limited in amount. The work of the gas-engine research committee has been continued at the University of Birmingham, and Prof. F. W. Burstall is preparing a report dealing with a new series of tests on the experimental engine at the University, varying only the ratio of air to gas, dealing also with the composition of the charge during expansion. Prof. H. C. H. Carpenter has concluded his research, referred to in the 1907 report, upon the production of castings to withstand high pressures. Of the remaining researches in the hands of special committees, that on the value of the steam-jacket is in abeyance at present, while that on the friction of various gears is awaiting the publication of the results of some experiments in the United States. It has been decided not to undertake experiments on "heat transmission" at present.

In the November (1910) number of the Bulletin of the Bureau of Standards Mr. B. McCollum describes and investigates the theory of a new form of dynamometer for the measurement of the quantity of electricity which flows through the instrument. It consists of a relatively large fixed coil with its axis horizontal, at the centre of which is suspended, by a long vertical wire, a smaller coil with its axis parallel to that of the larger coil. Attached to the moving coil is a cylinder of some homogeneous material with its axis coincident with that of the suspension. When the current is sent round the coils, a magnetic couple acts on the moving coil, tending to hold it with its axis parallel to that of the fixed coil, and if the moving coil is displaced it will oscillate about its axis of suspension. The quantity of electricity which passes through the coils during n swings of the coil is equal to

$$2\pi n\sqrt{K(1-T^2/T_0^2)/C},$$

where K is the moment of inertia of the moving system, T the time of swing with, T_0 the time without the current, and C is the constant of the coils which can be calculated from their dimensions. The investigations of the author appear to promise a degree of accuracy in the measurements comparable with that of the current balance.

The Central of January contains an article on "Crystal Structure and Chemical Composition" from the pen of Prof. W. J. Pope, F.R.S. It is no exaggeration to say that the theory which has been so admirably developed in recent years by Mr. Barlow and Prof. Pope is likely to prove equal in value with the work of Pasteur, van 't Hoff, and Le Bel, which culminated in the enunciation of the theory of the tetrahedral arrangement of the valencies of the carbon atom. The systems of close-packed spheres devised by Messrs. Barlow and Pope certainly give a more realistic picture of the actual arrangement of the atoms in the molecules of a crystal than the wide-spreading models which are commonly used to represent the tetrahedral theory, although the latter are of greater service in interpreting the chemical changes which the molecules may undergo. The widespread appreciation of the new theories of crystal structure has been hindered by the scanty distribution of crystallographic knowledge and by the difficulty of visualising the diagrams by which its essential features are expressed; a popular and simple exposition of his views by one of the authors of the theory is therefore doubly welcome. The same issue contains articles by Prof. Dalby on "The New Engineering Laboratories of the Central Technical College," by Mr. Tripp on "Cross-Channel Steamers," by Mr. Branch on "The Bonus System in a Machine Shop," and by Mr. Montgomery on "The Development of the Humphrey Pump."

The Silica Syndicate, Ltd., 82 Hatton Garden, London, E.C., has issued an illustrated descriptive catalogue of its transparent quartz-glass apparatus. Transparent quartz glass does not crack on subjection to violent and sudden changes of temperature. Its melting point is indefinite, but may be taken at about 1600° C.; there is, however, no trace of fusion at 1555° C. Above 1000° C. it is permeable to hydrogen. Its expansion up to 1000° C. is regular; above 1100° C. it contracts. The catalogue gives particulars of the numerous pieces of apparatus obtainable in this useful material, together with the current prices.

Bulletin No. 43 of the University of Illinois contains an account, by Prof. E. C. Schmidt, of experiments on freight-train resistance and its relation to average car weight. The tests were conducted by the Railway Engineering Department of the University of Illinois in 1908 and 1909; all were made by means of a dynamometer car owned jointly by the University and the Illinois Central Railroad, and were carried out on the Chicago division of this road. Results of tests on thirty-two ordinary freight trains are discussed; the average weight per car ranged from a minimum of 16·12 tons to a maximum of 69·92 tons, and the number of cars in the train varied from twenty-six up to eighty-nine. The results may be expressed by an equation

$$R = a + bS + cS^2,$$

in which the coefficients a, b, and c depend on the average weight W of the cars in the train in tons; S is the speed in miles per hour, and R is the resistance in pounds per

ton weight. A table of values of the coefficients is given for values of W from 15 tons up to 75 tons. This formula shows a maximum error of half of 1 per cent. when compared with the experimental results. Another empirical formula is given which has a maximum error of 9·5 per cent., viz.

$$R=\frac{S+39\cdot6-0\cdot031\ W}{4\cdot08+0\cdot152\ W}.$$

The formulæ are limited to conditions similar to those prevailing during the trials, viz. straight and level track of good construction, temperature above 30° F., wind velocity not more than 20 miles per hour.

In our notice of the fourth edition of "Les Roches et leurs Éléments minéralogiques," by the late M. Ed. Jannettaz, in December last (vol. lxxxv., p. 166), we complained of the description of the work as a revised and enlarged edition (Quatrième édition, revue et augmentée). We have now to acknowledge the receipt from the publishers, MM. Hermann et Fils, Paris, of another copy with modified cover and title-page, in which it is now described correctly as "Quatrième édition, conforme à la Troisième et augmentée de huit planches." The publishers assure us they had no intention of misleading purchasers by the wording of the former description. The work has at least the merit of cheapness, the price being only eight francs.

We have received from the Board of Agriculture and Fisheries a memoir of the Geological Survey, Scotland, entitled "Catalogue of Photographs of Geological Subjects," which has been prepared by the Geological Survey and Museum. The catalogue enumerates the first 1913 photographs taken to illustrate subjects of geological interest in Scotland. The number, subject, and locality of each photograph are given, and the number of the 1-inch map in which each locality occurs. The districts illustrated lie chiefly in the north-west Highlands, Skye, in the counties of Argyll, Perth, Aberdeen, Kincardine, Fife, Haddington, and Mid-Lothian. Copies of the catalogue, price 6*d*., can be obtained from any agents for the sale of Ordnance Survey maps, or through any bookseller.

OUR ASTRONOMICAL COLUMN.

Nova Lacertæ.—*L'Astronomie* for February contains a number of observations of Nova Lacertæ, and includes a reproduction of a spectrogram secured by Dr. Max Wolf, at Heidelberg, on January 2. In addition to the broad bright hydrogen lines, the outstanding features are the band at λ 463, several emission lines between Hβ and Hγ, a conspicuous break in the continuous spectrum on the more refrangible side of Hγ, and the strong emission line near λ 4056.

Nova Sagittarii, No. 3, H.V. 3306.—While examining a plate taken at Arequipa on September 6, 1899, with the 1-inch Cooke lens, Miss Cannon found a star image which appeared to be that of a nova in the position (1900) R.A. = 18h. 13m. 47·5s., dec. = −25° 13·5′; this is about 1′ north of the C.D.M. tenth-magnitude star −25° 13020.

The customary investigation of past plates revealed the fact that the light-curve of the star had the characteristics of the curves of novæ. A large number of photographs were examined covering the period June 7, 1889, to September 3, 1910, and many of them showed no trace of the nova. On plates taken on August 5, 6, 7, and 9, 1899, it is not shown, although the last-named shows a neighbouring star of magnitude 11·4, yet the photograph of August 10, 1899 (G.M.T. 12h. 28m.), shows it at full brightness, viz. magnitude 8·5; this photograph was taken with the 13-inch Boyden telescope, the exposure being 100m. Seven plates, taken for the cluster N.G.C. 6266, show a star of magnitude 15·6 in the position of the nova, within the limits of measurement, but this object exhibits no variability on five earlier plates or on five plates taken since 1905. Since August 10, 1899, the nova has appeared on twenty-six plates taken with various instruments at Cambridge (Mass.), and Arequipa, and on the last of these, taken on October 3, 1901, its magnitude was 13·3. The light-curve shows that the brightness decreased rapidly at first, but was nearly stationary, at magnitude 12·0, from April to July, 1900. A plate accompanying Circular 183 of the Harvard College Observatory reproduces the photographs of the nova's region taken on August 3 and 10, 1899.

The Satellites of Mars.—Observations of Phobos and Deimos during the opposition of 1909 are recorded by Prof. Lowell in No. 50 of the Lowell Observatory Bulletins. Several interesting observations relating to the apparent magnitudes of the two satellites are described, Phobos generally appearing the brighter. Thus on September 16, 1909, it was half a magnitude brighter than Deimos, although with reduced apertures—6 inches being the limit—it was the fainter.

From a discussion of the data obtained, Prof. Lowell finds that Phobos is probably 2·48 times the diameter of Deimos, has 6·15 times the visible surface, and, if the densities are equal, has 15·25 times the mass. The data are too meagre to give a definite conclusion, but, so far as they go, they suggest that there is a difference of brilliancy in one, or both, of the satellites, dependent on their orbital positions; this suggests that each satellite has different local albedoes, or an irregularity of shape, and that it always keeps the same face towards Mars.

The Spectra of some Wolf-Rayet Stars.—Bulletin No. 182 of the Lick Observatory contains a note by Mr. J. C. Duncan describing the spectra of seven Wolf-Rayet stars photographed by him, with the one-prism spectrograph mounted on the 36-inch refractor, during the summer of 1908.

Many of the lines and bands shown on these photographs exhibit no notable differences from those published by Prof. Campbell in 1894, but those given in the following table did not appear in the earlier publication:—

λ of centre of line or band	Star B.D.	Description of line or band
4120·84 ...	+35°3953 ...	Narrow dark line
4068·40 ...	+30°3639 ...	,, bright ,,
4630 ...	+36°3956 ...	,, faint band
4058 ...	+36°3987 ...	Fairly bright band 15 A.U. wide
4099 ...	+36°3987 ...	,, ,, 34 ,,
4628 ...	+36°3987 ...	Faint band 54 A.U. wide
4056 ...	+37°3821 ...	,, ,,

Southern Nebulæ.—Two notes describing remarkable southern nebulæ appear in No. 5 of the Transvaal Observatory Circulars.

The first deals with a great ring nebula in Aquarius (N.G.C. 7293, Harding; 22h. 23m., −21° 26′), which is nearly circular and has a diameter of 11′. Mr. Innes describes it as a remarkable object, looking like a ring nebula superimposed on a planetary nebula, and states that it was first seen in the 2-inch finder. This points to the description "very faint" in the N.G.C. being incorrect, or the nebula is variable; it is difficult to account for its being missed, with its present brightness, by Messier and the Herschels. From a photograph taken on October 4, 1910, with 60m. exposure, Mr. Woods describes the nebula as a broad, continuous ring extending across 52s. in R.A. and 12·6′ in declination, and appearing slightly fainter in 135° and 315° than at other parts.

The second object was discovered on a plate taken by Mr. Mitchell on August 1, 1910, with the Franklin-Adams star camera, with an exposure of 2 hours. This is a large, irregular nebula, around and preceding π Scorpionis, which is not mentioned in any of Dreyer's three catalogues. Its position is 15h. 53m., −25° 50′, and it extends over 1° in a north and south direction, its other diameter being about ½°.

A Slowly Moving Meteor.—A fairly bright meteor, remarkable for the leisurely rate at which it moved, was seen by Mr. F. E. Baxandall, at Putney, at 9 p.m. on February 19. It first appeared in about 169°, +39°, and, travelling very slowly, passed through 211°, +28°, finally disappearing below the north-east horizon after a flight lasting fully 15 seconds.

GEOLOGICAL WORK IN BRITISH LANDS.

I.—IN ASIA AND IN AFRICA.

PART iv. of vol. xxxviii. of the Records of the Geological Survey of India (1910) contains two papers by Mr. Murray Stuart on the oil-bearing beds of western

FIG. 1.—Silt-beds uptilted by recent earth-movements, near head of Son-Sakesar Lake, Punjab.

Prome and Kama, in Lower Burma. Maps and an ideal section are provided. The strata of economic interest, the Kama clays, are of Miocene age, ranging from Burdigalian to Pontian. The author considers the palæontological evidence in some detail, following the determinations of Dr. Noetling. Mr. Cotter treats of part of the Yenangyat oilfield, of which a special map is given. Mr. Datta describes siliceous hæmatites from Chanda, in the Central Provinces, some of which are already used as iron ores. One would like to hear something of the relations of the lodes to the surrounding rocks, for comparison with similar materials in South Africa. The remainder of part iv. is occupied with the results of Captain R. E. Lloyd's visit to the Aden Hinterland, a country rarely visited. The author was able to travel ninety miles inland along a line due north from Aden, terminating at the town of Dala. Here bedded lavas and ashes cover much of the country, and Mr. Vredenburg (p. 322) suggests that these are representatives of the Deccan Trap. Captain Lloyd shows them to be younger than certain Jurassic strata, and they have been carved out by denudation into plateaus. These lie (p. 317) as much as 6000 feet above sea-level. The volcanic rocks are mostly basalts and dolerites without olivine, in this recalling the Deccan series. A curious rock is described on p. 330, consisting of minute augite prisms in a green ground of devitrified glass, with spherical vesicles infilled by zeolites, triclinic felspar, and epidote. It may be of interest to remark that a precisely similar infilling of vesicles is found in an andesite from Brighton, Massachusetts. Mr. G. H. Tipper describes (p. 336) the Jurassic fossils collected by Captain Lloyd, which agree with a series previously described by Messrs. Newton and Crick as indicating a fairly high horizon. Perisphinctes is the prevailing ammonite.

Vol. xxxix. of the Records is occupied by a review of mineral production from 1904 to 1908. In vol. xl. (1910) Mr. F. R. Cowper Reed, of Cambridge, discusses (p. 1) the distribution of life in pre-Carboniferous life-provinces, with especial reference to recent work in Asia. "It is no longer possible," as he usefully remarks, "to maintain that the diffusion of Lower Palæozoic life was uniform." Mr. La Touche (p. 30) very interestingly shows that recent beds of silt, laid down in some cases in old channels of overflow, have been tilted by earth-movements in the lake-district of the Punjab Salt Range (Fig. 1). The hollows of the lakes themselves are, with one exception, due to faults or synclinal basins in nummulitic limestone. Among the plates from this area is a fine one (Plate x.) showing a "bad land" produced by the erosion of æolian loess. Mr. La Touche also illustrates excellently "certain glaciers in Sikkim" (p. 52, and Plates xv.–xxiv.). These glaciers show marked features of retreat during the last fifty years. One of them is formed from snow-slides already charged with débris, and is choked from its very beginning "to its fullest capacity with moraine stuff" (Fig. 2). It thus becomes almost a rock-flow, in which the stones are held together by ice, and no ice is visible except where it breaks into cliffs (p. 56). Mr. G. E. Pilgrim (p. 63) describes several new genera and species of mammals, mostly from the Siwalik beds. A giraffoid skull in the British Museum is now styled Indratherium.

On p. 185 Mr. Pilgrim summarises his present results as to the correlation of the tertiary fresh-water deposits of

FIG. 2.—Part of the stone-filled Alukthang Glacier, Sikkim, showing ice only where fracture occurs.

India. He points out that more than a hundred species of vertebrates from N.W. India have been assigned to no special horizons, though derived from a series of beds some 20,000 feet in thickness. He therefore supplies a table showing their vertical distribution, which should do much

to clear the way for an appreciation of the successive faunas. The Lower Siwalik Beds, with *Deinotherium indicum* and *Tetrabelodon angustidens* are classed as Tortonian and Sarmatian; the Middle Siwalik Beds, with Mastodon, Stegodon, Hipparion, and Helladotherium, as Pontian; and the Upper Siwalik Beds, with Equus, Bos, Elephas, and Sivatherium, as truly Pliocene. Mr. C. S. Middlemiss (p. 206) revises the "Silurian-Trias sequence" in Kashmir, in a paper covering a wide field.

In the Quarterly Journal of the Geological Society of London, vol. lxvi., part iii., p. 420, Mr. J. B. Scrivenor describes the relations of the igneous rocks of islands between Johore and Singapore, and connects these rocks successfully with types in Borneo and Amboyna. A granite has caught up masses from a gabbroid magma, while this magma has in turn invaded the consolidated granite. The paper is important for those who have to consider the question of segregation-patches as against inclusions brought up from below. In a subsequent paper (p. 435) Mr. Scrivenor describes a number of remarkable rocks from the Kinta Valley of Perak, consisting of tourmaline and corundum. These mostly contain carbon as a separate constituent, and are "evidently derived from certain beds forming part of a series overlying massive beds of limestone." Residual structures remain in these highly altered rocks which strongly suggest oolitic grains. The mineralisation is believed to have taken place during extensive intrusions of granite in the district. Cassiterite "frequently occurs in schists with which the tourmaline-corundum rocks are associated."

If Egypt, for geological purposes, may be included as a British land, it should be mentioned that Dr. Hume, the director of its Geological Survey, has published a memoir on "The Building Stones of Cairo Neighbourhood and Upper Egypt" (Survey Department Paper No. 16, 1910, price 150 mmes.). Maps of the quarry-areas are given, with names in Arabic and English. Analyses of many of the limestones are quoted, and their durability and power of absorbing water are considered. Much of the information was collected by the late Mr. T. Barron.

Dr. Hume also states his views on "The Origin of the Nile Valley in Egypt" (*Geological Magazine*, 1910, p. 385). He believes that the dome-structure of the strata in the Gulf of Suez has been cut across by notable fractures, of which there is still more marked evidence in Sinai. But the main structure of Egypt and of the Nile Valley lying in it has been determined by folding and erosion rather than by trough-faulting. Egypt is formed by a synclinal following on the "wave-crest" that is revealed by the Eastern Desert and Sinai. The Nile ravine follows the axial line of the centre of the synclinal trough, and has been assisted by the presence of easily eroded Cretaceous and Middle Eocene strata. A transverse system of folds, fairly east and west, is also traceable. The oases seem to be due, in the first instance, to the main north and north-west folding.

The Cairo Scientific Journal for September, 1910, contains a general review of the origin of petroleum, by Dr. Hume, with special bearing on the Egyptian oil-area at Gebel Zeit. The author inclines to the view that the Egyptian oil is derived from animal matter included in the deposits of a drying Mediterranean Sea, and points out that the associated gypsum supports this theory. Major H. de Lotbinière (p. 221) shows how the clays in the Nile Valley bear up the water now introduced by irrigation into the overlying sands and the cracked clays of the surface. This rise in the water-table, discussed by Mr. Ferrar and others, is one of the newest agricultural problems that Egypt has to face.

South Africa continues to produce a wealth of geological memoirs. The Transvaal Mines Department issues an explanation of Sheets 5 and 6 of the large-scale geological map, covering the country round Zeerust and Mafeking (price 2*s*. 6*d*.). The Geological Commission of the Cape of Good Hope has allowed the use of its map to complete the Mafeking sheet drawn up by its neighbour. Messrs. Hall and Humphrey, authors of the memoir, point out the large part played by contact-metamorphism in the rocks of the Pretoria series of the Transvaal system. The Bushveld plutonic complex is held to be responsible for the widespread production of slates with biotite, cordierite, and andalusite. The gold-bearing quartz-reefs along the Malmani River near Ottoshoop are reported on, and it is suggested that work in them was abandoned when the water-level in the adjacent dolomite was reached. Hill-shading has been added to these maps, which is a great improvement. It is doubtful, however, if the rivers on a heavily coloured geological sheet should be shown in blue, since it is always important to trace out their courses at a glance. The geologists, moreover, are probably not responsible for the choice of scale, which is provokingly near 1 cm. to 1 mile, but still nearer 3 inches to 7 miles. This is a heart-rending thing to work with, whether miles or kilometres are familiar to one's mind.

Mr. A. L. Hall has written for the Transvaal Survey an important memoir on the "Pilgrims' Rest Gold Mining District" (1910, price 7*s*. 6*d*.), in which a large map of the Lydenburg and Barberton districts is inserted. The great escarpment of the Drakensberg, formed of the lowest sandstones of the Transvaal system, runs from north to south down the eastern part of the area, and the hill-shading portrays for the first time the numerous immature valleys dropping steeply from it to the broken granite lands of Barberton. The Blyde River has an interesting course, mainly on the Dolomite, past Pilgrims' Rest, within and parallel with the escarpment, catching the first waters on the dip-slope, and escaping finally over the edge by a long notch in which the granite is exposed. Its basin is clearly threatened by the recession of the great escarpment. Westward, the beds of the Pretoria series, above the Dolomite, come in, remaining almost level over broad areas, as we reach the true plateau-land of the Transvaal. The general fall of the country northward to the Olifant's River is seen, however, in the parallel courses of the streams, of which the Blyde River is the most easterly, and their valleys give a rolling character to the landscape. The important auriferous deposits of the area consist mainly of quartz-reefs lying at definite horizons in the Dolomite, with certain cross-reefs cutting across the bedding. An area for future prospecting is indicated towards the Olifant's River (p. 144). The handsome illustrations in this memoir will interest anyone who has stood on the Drakensberg edge in eastern Transvaal, and has seen the huge inland plains terminate suddenly against the highland air. Yet here, as Prof. Penck has urged, it is not necessary to invoke a fault to account for the rapid fall towards the Indian Ocean. Folding and erosion, the same processes that have given us our Chilterns and our Cotteswolds, seem alone responsible for the impressive margin of the veld.

The Geological Commission of the Colony of the Cape of Good Hope has published in 1910 Sheets 32 and 40 of the map on the scale of 1 inch to 3·75 miles. Here, again, the scale, 1 : 238,000, has a truly British and uncompromising air. Sheet 32 has Van Wyk's Vlei near its centre, where depressions occur on rocks of the Ecca series, between flat-topped kopjes. The dolerites in the Karroo system form characteristic ring-like outcrops. Sheet 40, showing the country around Marydale, includes the north-westerly stretch of the Orange River on the edge of Griqua Land West. It is a very interesting map for the student, as may be seen at once in the section at its foot. The contrast of the old schists on the west, invaded and almost eaten up by granite, with the undulating beds of the Transvaal system on the east, is only one of its many attractive features.

We cannot do justice to the numerous papers in the Transactions of the Geological Society of South Africa. Prof. Schwarz (vol. xi., 1909, p. 107) points out the interest of the occurrence of high Senonian or Danian beds (the Alexandria formation) on the south coast of Africa. Their age appears to be determined by Mr. W. D. Lang from the polyzoa only, and they seem to have been deposited near a shore. Their position implies an epoch of submergence after the elevatory movement that carried the Lower Cretaceous Uitenhage beds to a height of 4000 feet above the sea. The discussion on this paper will be found in vol. xii., 1910, p. xxxv. Dr. Rogers here points out that there may not be such a gap in the African Cretaceous as Prof. Schwarz suggests, if we regard the Pondoland beds as Senonian rather than Cenomanian. Mr. Recknagel (vol. xi., p. 83) has the advantage of describing a new field in his paper on some mineral deposits in the Rooiberg district, where tin-ore and tourmaline figure

largely. Yet even here (p. 89) certain unknown primitive miners sought tin in fairly deep diggings before the present natives occupied the country. The same author (vol. xii., 1910, p. 168) reviews all the occurrences of tin-ore in South Africa, and concludes that cassiterite in workable quantities is a product of differentiation in granitoid magmas, and that lateral secretion accounts for its concentration in certain veins.

Mr. A. L. Hall (vol. xii., p. 8) describes schistose structures in the Bushveld granite as having arisen marginally through pressure during consolidation. Mr. H. Merensky (p. 13), in a short but important paper, urges that the diamonds of Lüderitzland, in German South-West Africa, which occur in an æolian sandstone, must be derived from an underlying sandstone, which he proves to be of Cretaceous age. Mr. P. A. Wagner (vol. xiii., 1910, p. 56) shows that dykes of monchiquites, allied to kimberlite, occur in the Pomona district of this region, and in this district the largest diamonds have been found. Prof. R. B. Young, of Johannesburg (vol. xii., p. 82), supports the view that the gold of the banket conglomerate of the Rand was imported, with the pyrite, after the deposition of the beds. He believes that a heavy mineral, such as titanic iron-ore, was present as an original detrital constituent, and promoted the precipitation of auriferous pyrite. He traces a second generation of gold, distributed more irregularly than the first. He suggests that the gold was brought in by solutions arising from igneous rocks, both basic and acid, that penetrate the Witwatersrand series. The acid intrusive rocks have been described for the first time by Mr. M. Weber (*ibid.*, p. 67), who has detected gold in them. The future must show whether the gold in these igneous rocks has or has not been derived from other rocks through which they have passed in their ascent.

A question that attracts even more interest in South Africa is raised by Mr. H. S. Harger's paper (p. 139) on the occurrence of diamonds in Dwyka conglomerate and amygdaloidal lavas, and the origin of the Vaal River diamonds. Mr. Harger is a specialist in diamond-bearing pipes, and he believes that some of the material in old alluvial gravels above the Vaal River has been derived from local kimberlite. He regards, however, most of the blocks associated with the diamonds as torn from more distant masses by the ice of Permo-Carboniferous times. The gravels are, in fact, concentrates from lost patches of Dwyka conglomerate. He shows that the so-called "bantam" pebbles, commonly associated with diamond on account of their specific gravity of 3·3, are probably worn from a metamorphic rock rich in manganese-garnet, and he traces these pebbles to the Dwyka beds. He finds, moreover, diamonds in the andesitic lavas that are older than these strata, and urges that the gems originated in these lavas, and were carried thence into the conglomerate, and thence into the residual gravels. In the discussion reported on pp. lvii–lix of the Proceedings of the society for 1909–10, Mr. Harger defends his position by recording the occurrence of diamond in the Dwkya conglomerate at Windsorton. He does not, however, encourage the exploitation of this intractable and unconcentrated series. We do not seem nearer to the actual parent rocks of the diamond, which may well lie in some metamorphic zone, from which the gems became picked off into the lavas. Mr. C. Baring Horwood (vol. xiii., p. 29) publishes and discusses a number of analyses of typical Transvaal rocks, including the dolomite and its partly silicified varieties. In association with Mr. A. Wade, he has recently reviewed the whole series of "old granites" in South Africa (*Geological Magazine*, 1909, pp. 455 and 497), and concludes that there is a real fundamental granite-gneiss formation in that portion of the globe. The state of affairs, however, as he fairly enough points out, is somewhat suspiciously like that in Canada, where the fundamental series tends to become more and more visionary every year. Dr. Rogers, in his address to the South African Association for the Advancement of Science, in November, 1910, clearly differs from Mr. Horwood in regard to the African series, and points out that the oldest gneisses are igneous intrusions including flakes of sediments (Reports, Section B, p. 30).

Mr. F. P. Mennell (Quart. Journ. Geol. Soc. London, vol. lxvi., 1910, p. 353) claims the great mass of rocks in southern Rhodesia as "Laurentian"; but he is convinced that the granitoid mass which forms so large a part of the country is younger than the series of schists, banded ironstones, and limestones, and he holds that mixed rocks are important features of the contact-zones. The present writer has had the advantage of seeing some of these composite gneisses under Mr. Mennell's guidance near Bulawayo. Interesting cases of the absorption of granite by dolerite, recalling the reverse action near Carlingford in Ireland, are described on p. 372. Mr. Mennell, in referring to two Rhodesian examples of "blue ground" pipes containing diamonds, declines to connect the diamonds with the prevalence or non-prevalence of eclogite-fragments or of garnet. This is in contradiction to the view of the Vaal River diggers, as quoted by Mr. Harger in the paper already referred to, since the "bantams" on which they so much rely prove to be largely made of spessartine. Geologists may well envy the field open to Mr. Mennell, Mr. Molyneux, Mr. Zealley, and now to Mr. Maufe, who between them are attacking an area at least as large as the Transvaal.

G. A. J. C.

THE AIRSHIP FOR THE BRITISH NAVY.

THE leading article in *Engineering* for February 17 gives some account of the airship for the British Navy built by the Vickers Company at Barrow. Trials were conducted on Tuesday, February 14, in presence of the Government's Advisory Committee on Aëronautics, these being analogous to the basin trials of a warship, and have proved to be quite satisfactory. The structure for accommodating the hydrogen reservoirs or balloons is 512 feet in length and 48 feet in diameter. It is in the form of a decagon in section, and the ten sides are built up of longitudinal lattice-girders, with vertical intercostal girders, the top and bottom boom in each case being formed of angles or tees of duralumin. Each bay has diagonal wire bracing. The form is whale-like, with a bluff entry, and a sweet run aft to a point, where, at the bottom, there is a big fin, increasing in depth aft according to the upward rise to the point of the stern. Aluminium was first tried, but the girder structure of this metal collapsed under stress. The metal adopted—duralumin—is one of the magnesium alloys of aluminium, and contains 91 per cent. of aluminium. It has a specific gravity between 2·77 and 2·84, a melting point of about 650° C., a yield point varying from 12 to 16 tons per square inch according to the hardness, and a breaking resistance from 22 to 29 tons per square inch. The elongation varies from 23 to 18 per cent., and the contraction of area from 34 to 26 per cent. It will thus be seen that, despite its lightness, it bears comparison with mild steel.

For more than half the length of the structure there is a bottom girder, or keel, of V shape, carried on the girder structure of the decagon. The bottom is flattened with spruce grating, laid inside to form a gangway, and serves as a means of communication between the two gondolas. The gondolas are connected to the central girder, and are constructed of timber of ship-shape form. Should the ship alight on water, the structure will float by reason of the buoyancy afforded by the hydrogen gas contents of the reservoirs. Both gondolas contain a typical ten-cylinder Wolseley marine petrol-motor with reversing clutch. The engine in the forward gondola has two propellers, each with two wooden blades. There is one on each side at a considerable elevation above the gondola, supported on duralumin raking girders. The engine in the after gondola drives a single two-bladed propeller abaft the gondola, with only a reversing coupling between propeller and engine.

To give lifting power, eighteen or twenty gas-bags are used, the structure for the hydrogen reservoirs being divided vertically into compartments by rope netting. The covering of the structure was the subject of experiments at the National Physical Laboratory, and, as a result, silk coated with a proofing by the Ioco process was preferred. This weighs about 100 grams per square metre, has fire-resisting qualities, and is of British manufacture. The upper half is coated with aluminium dust in order to reflect the sun's rays, while the lower half retains the yellow shade of the silk.

To enable the ship to rise or descend during flight there are three parallel horizontal planes on both port and starboard sides, forward and aft. These are comparatively small, pivoted in the centre at each side, with a vertical rod at each corner, and through these all are tilted to the desired angle by wire gear operated from either gondola. For lateral movement there are three groups of vertical rudders, one having four parallel planes above and a similar one below the main structure near to the stern, while abaft of the propeller, in the after gondola, there is a group of three rudders. Rudders, engines, and propellers were worked before the members of the advisory committee at the trials. The committee are to be congratulated, as well as Captain Sueter, who has had charge of the work on behalf of the Admiralty, and also the Vickers Company on the important stage which their unique work for the Navy has now reached.

INFANT AND CHILD MORTALITY.[1]

THE report before us is one of the most important studies of infantile mortality yet produced. Administratively, it will be of immense value, for it constitutes a first guide to the "dark areas" of England. Scientifically, it is also of value, for it brings actual administrative data to bear on a fundamental social question, namely, does the prevention of infant deaths tend to the deterioration of the race? Whatever be the final reply to this question, the work of prevention will certainly proceed as if the question had never been asked, because the impulse towards prevention is itself a fundamental impulse in modern society, and will realise itself against all hindrances.

It is, however, of immense importance to know whether, on the whole, the methods of prevention in this particular field are favourable to the rearing of a sound race or not. Survival of the fittest, however, is no longer to be imaged merely as survival of individuals of a single quality. Rather it is imaged as survival of fit groups, and the concept of the "group-person" is steadily gaining a place, not in biology alone, but also in economics. The preservation of the "group-person" implies that natural selection must be regarded as operating on the group, not on the mere individual considered abstractly. Consequently, it may well happen that, as the preservation of the group is the primary and immediate object of social organisation, the preservation of a certain proportion of relatively weak individuals may be ultimately harmless even on the most stringent interpretation of the Darwinian principle of natural selection. At all events, it is important to have the problem studied in detail, as is the case in this well-loaded document. If it turns out that the preservation of the individual does not, even in a minor degree, impair the fitness of the group, all the better.

It is this important consequence that Dr. Newsholme's investigation, so far as it goes, tends to establish by actual facts. The administrative results we may leave alone. One of the primary intentions of the report was "to determine, on the basis of our national statistics, whether reduction of infant mortality implies any untoward influence on the health of the survivors to later years" (p. 1). The figures of a single year, 1908, are taken and carefully analysed. The counties of high infantile mortality are compared in sufficient detail with the counties of low infantile mortality. Infantile mortality is compared and correlated with the mortality at later ages—age one to two, two to three, three to four, and four to five, and even at age-groups five to ten, ten to fifteen, fifteen to twenty. In this way, data variously presented are obtained for testing the influence that the infantile mortality has on the mortality of the survivors, even up to adult ages.

"This comparison is important, because attempts to reduce infant mortality are regarded by many as an interference with natural selection, which must be inimical to the average health of those surviving. According to this school of thought" (we think Dr. Newsholme too generous, if he is not ironical, in dignifying those somewhat casual theorists by the name of "school"), "efforts to save infant life merely prevent the weeding out of the unfit, and ensure the survival of an excessive proportion of weaklings" (p. 9). The results of the "correlations" are startling, though some of them may equally be come at by general reasoning. However we turn the figures, it remains true that "a high infant death-rate in a given community implies, in general, a high death-rate in the next four years of life, while low death-rates at both age-periods are similarly associated" (p. 13). Thus of the eight administrative counties with highest infant death-rates, the infant death-rate was 139·1 per 1000 births, and the death-rate at age one to five was 69·2, while in the eight administrative counties with lowest infant death-rate, the corresponding figures were 77·9 and 32·6.

This relationship is found also in the comparisons of the individual counties. But the correlations reveal the further fact that at the later ages the same general relation is true. "Speaking generally, it will be seen that the eight counties having a high infant mortality also had a relatively high death-rate of males during each of the four first lustra of life, and the eight counties having a low infant mortality had also a relatively low mortality at ages 0–5 and 5–10, and to a diminishing extent at 10–15 and 15–20" (p. 16). Probably at the later ages other special influences, such as migration, complicate the issue.

The problem of the "selective influence" is analysed and estimated in greater detail in a special section by Mr. Udny Yule, whose general conclusion, from somewhat inadequate data, is "that there is little definite evidence of such selection beyond the second year of life, and that after the third year the environmental influences even of infancy alone appear to preponderate over any possible selective influence" (p. 78). There is no space even to indicate the wealth of fact that goes to the discussion of the causes of infant mortality. The broad conclusion is that no effort should be spared to reduce the mortality of infants and to remove all removable causes of death. Philanthropic impulse is thus reinforced by scientific analysis of the facts. This report will be followed next year by a similar study of infant mortality in the large towns. Dr. Newsholme is to be congratulated on his admirable combination of scientific analysis with practical administration.

[1] Supplement to the Thirty-ninth Annual Report of the Local Government Board, 1909–10. By Dr. Arthur Newsholme, Medical Officer to the Board. (London: Wyman and Sons, Ltd., 1910.) Price 1s. 3d.

FIXATION OF ATMOSPHERIC NITROGEN.

SINCE the work of Lord Rayleigh in 1894, when he repeated the experiments of Cavendish with improved apparatus and more modern methods, continual progress has been made in connection with the oxidation of atmospheric nitrogen. Rayleigh's experiments, carried out on a large laboratory scale, showed the feasibility of obtaining nitric acid or nitrates from the atmosphere, and, given cheap power and appropriate appliances, the possibility of it being done on a paying commercial scale.

The pioneering work which followed for a long time spelt—commercially—failure. But as first one idea and then another was shown to be unsatisfactory, and had to be discarded, knowledge increased, as is always the case with research, and in 1903 Birkeland and Eyde designed and erected a plant which, at any rate, in part solved the problem. In a lecture delivered before the German Association of Naturalists and Physicians in September last, Prof. J. Zenneck takes up the subject at that stage, and reviews this process and others which have since been devised (Leipzig: S. Hirzel, 1911). The lecture was evidently delivered to a popular audience, because Prof. Zenneck describes and illustrates the processes in a way which will interest and instruct those who may have very little knowledge of chemistry. For example, by means of a model, he showed how in the Notodden process of Birkeland and Eyde the air is driven by means of a compressor through the furnace containing the disc-shaped arc, then how gases are partially cooled and the heat given up is used for the generation of steam and for evaporating the liquors. We believe, indeed, that coal is not required in the works at all for heating purposes. The Notodden plant, however, is so well known that it will be superfluous to describe it further, except to mention that very good diagrams and pictures of the works are included in the printed lecture.

Prof. Zenneck then describes the Pauling process. It is a well-known fact that vigorous blowing will put out the electric arc, consequently it is not an easy matter to blow air through an arc so that the nitrogen may become oxidised without blowing out the arc. In the process of Pauling, air is blown through an arc. The arc, however, is struck between horn-shaped conductors, such as are used as lightning arrestors. The two horns are closest together near the bottom, and it is here that the arc is struck. Owing to the ascending hot air, the arc rises upwards, and is broken once for each period of the alternating current. A new arc, however, is immediately produced again at the bottom, and this goes on continuously. An air current is also driven at high speed through the electrodes, and this further elongates the flames, so that an arc of very considerable length is produced. This process is now in successful operation in Switzerland and the south of France.

Special attention is given to the interesting process of the Badische Anilin- und Sodafabrik. This particular process was illustrated experimentally at the International Congress of Chemistry held in London in May, 1909. An arc is caused to form throughout a long tube, and the air is blown in tangentially. In practice, arcs of 8 metres long are employed.

Which of these three processes will best stand the test of time remains to be seen. The *sine qua non* in all cases is, however, cheap power. In structional details each plant is being continually improved, and at present each of these processes is being commercially worked. The Paulin process is, we believe, very well adapted for the manufacture of concentrated nitric acid, which is so important in the manufacture of explosives, and if sufficiently cheap may readily be converted into a fertiliser. The other two processes are certainly well adapted for the manufacture of fertilisers, and there is no inherent reason why nitric acid should not also be produced in all cases.

F. M. P.

BIRD NOTES.

In a lecture on the birds of Victoria delivered to the local Field Naturalists' Club in September, 1910, and published in vol. xxvii., No. 8, of the *Victorian Naturalist*, Mr. J. A. Leach directed attention to the extraordinary, and apparently unique, richness of Australia in birds. Not only, he remarks, has the country its own peculiar types of interesting birds such as emeus, maileebirds, black swan, laughing jackass, cockatoos, many parrots, lyre-birds, bower-birds, &c. (some of these being common to New Guinea), but it likewise contains representatives of every widely spread family of birds with the exception of vultures and woodpeckers.

To vol. vi., No. 2, of the Journal of the South African Ornithologists' Union Messrs. Bucknill and Grönvold contribute a paper on the eggs of certain South African birds, which, for the most part, have not been previously described or figured, the paper being illustrated by an exquisite coloured plate. The largest egg figured is that of the African hawk-eagle (*Eutolmaëtus spilogaster*), one of a pair taken in Matabeleland in 1904, and now in the Transvaal Museum. Perhaps the most interesting of all is the egg of *Poliohierax semitorquatus*, which, in its uniform whiteness, corresponds with those of the nearly related Indo-Malay falconets (Microhierax). In 1902, when the second volume of the "Catalogue of Birds' Eggs" was published, the British Museum possessed one clutch of eggs of Microhierax, but none of the allied African genus.

The third part of vol. x. of the *Emu* (December, 1910) contains a report of the tenth annual session of the Royal Australian Ornithologists' Union, held at Brisbane in October. Special attention was directed to the need for protecting Australian birds, and it was decided to request the Government of Tasmania to take action for protecting the penguins on the Macquarie Islands. Mention was made of the founding of a Gould League for the purpose of encouraging a love of birds among the rising generation. At one of the meetings the State Governor, Sir William Macgregor, expressed himself in favour of bird-protection, but had doubts as to the feasibility of its enforcement. His Excellency stated as an example of this difficulty that when in British New Guinea he passed laws for the protection of birds-of-paradise, and that these were nearly fatal to the red species. For during his absence a visitor asked permission to obtain one or two specimens for scientific purposes, and, having obtained it, straightway proceeded to shoot all that were obtainable, so that when the Governor, on his return, visited Ferguson Island he found not a single full-plumaged bird of this species remaining.

Country Life of January 1 contains two life-size illustrations of the newly named Irish coaltit, placed alongside those of its British representative, with descriptive notes by Mr. W. R. Ogilvie-Grant. The Irish bird is characterised by the light patches on the sides of the head and neck, as well as the occipital spot, being pale mustard-yellow, instead of white; the back olive-grey washed with yellowish cinnamon, in place of olive-grey; the upper tail-coverts cinnamon, in marked contrast with the rest of the upper parts, instead of brownish-fawn, not decidedly different from the back; the breast and belly whitish, washed with mustard-yellow, in place of whitish or greyish-white; and the sides and flanks cinnamon, instead of fawn. In freshly killed examples the mustard-yellow is bright and conspicuous, but fades a few days after death. The British coaltit, which Mr. Grant regards as a subspecies (*Parus ater britannicus*), occurs in County Down, a fact, in his opinion, affording additional evidence in favour of regarding the Irish bird (*P. hibernicus*) as a separate species.

Considerable discussion, reported in various issues of the *Field*, has taken place at the British Ornithologists' Club with regard to white-breasted British cormorants. While some ornithologists regard all such birds as immature, others maintain that certain examples are much older, and consider that one particular skin belonged to a bird of from twelve to fifteen months old. It was also suggested that white-breasted birds appeared sporadically in certain colonies, where they might become the dominating type.

Notes on the peregrine falcon in the Midlands and on the habits of the crested grebe are contributed to the January number of the *Zoologist* by Mr. O. V. Aplin. The former species, it appears, is still a regular visitor to the southern Midland counties, but the birds seen there in autumn are, in most instances at any rate, immature.

Of a very different character from all the foregoing is a paper by Mr. H. C. Tracy, issued in the Zoological Publications of the University of California, on the significance of white markings in passerine birds. The object of the inquiry on this subject undertaken by the author was to endeavour to reconcile the old theory that white markings in birds are recognition-signs, with the newer, and apparently contradictory, hypothesis that they are for protective purposes. The result, in Mr. Tracy's opinion, is that both theories are perfectly true and mutually supplement one another. Markings which are displayed only or chiefly when the birds are in flight, such as the white area at the base of the tail-feathers common to many terrestrial birds—as in our own wheatear—are recognition-marks, and it is noticeable that these are specially developed in gregarious groups. On the other hand, in the case of arboreal species, white markings at the base of the flight feathers, which become specially conspicuous when their owners are in flight, appear to serve for protection and for recognition. The author took, for instance, specimens of the green-backed goldfinch (*Astragalinus psaltria*) and black-headed grosbeak (*Zamelodia melanocephala*), in which these particular markings are well developed, and, after spreading the wings, "photographed them against sunlit foliage and backgrounds of leaves with spaces of sky showing through. The birds were difficult to find in the resulting prints. Undoubtedly the photographs, by their lack of relief, exaggerated the concealing effect; yet that there is such an effect, in general, it is safe to admit." Later on, it is added that when the bird takes wing, a different principle comes into play, and, as there is no broken background, the markings stand out conspicuously. "When we consider," continues the author, "the value to all birds ranging in the open foliage of instant recognition at a distance and sight-clues for the purpose of keep-

ing together, we shall not easily believe that wing and tail white are solely features of concealing coloration. Their revealing function during flight is entirely in harmony with their concealing functions when at rest."

In conclusion, brief reference may be made to the paper by Mr. E. A. Wilson, field-observer to the Grouse-disease Inquiry Committee, in the Zoological Society's Proceedings for December, 1910, on the changes of the plumage in the grouse, a communication specially noteworthy on account of the excellence and beauty of the numerous coloured plates by which it is illustrated. R. L.

THE AUSTRALASIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THIS year's meeting of the Australasian Association for the Advancement of Science was held at the University of Sydney on January 9–14, under the presidency of Prof. Orme Masson, F.R.S., professor of chemistry in the University of Melbourne.

The work of the meeting was divided among eleven main sections, each with its own president, vice-president, and secretary. The following is a list of sections with the name of the presidents and the subjects of their addresses, when these are stated in the official circulars which have been received.

Section A, Astronomy, Mathematics, and Physics: Prof. T. H. Laby, professor of physics in Victoria College, Wellington, N.Z. Section B, Chemistry, Metallurgy, and Mineralogy: Prof. B. D. Steele, professor of chemistry in the University of Queensland, Brisbane, who in his address dealt with inorganic solvents. Section C, Geology: Prof. P. Marshall, professor of geology in the University of Otago, Dunedin, N.Z., whose address was on the western margin of the Pacific basin. Section D, Biology: Mr. F. M. Bailey, Government botanist at Brisbane. Section E, Geography and History: Prof. G. C. Henderson, professor of history in the University of Adelaide, whose address discussed colonial historical research. Section F, Anthroplogy and Philology: Mr. Edward Tregear. Section G, (1) Social and Statistical Science: Mr. E. W. H. Fowles, the subject of whose address was unemployment. Section G, (2) Agriculture: Prof. W. Angus, late director of agriculture in Adelaide. Section H, Engineering and Architecture: Mr. Ellwood Mead, who was unable to attend the meeting, and instead of a presidential address, Prof. W. H. Warren, of the University of Sydney, delivered a lecture on irrigation in India. Section I, Sanitary Science and Hygiene: Dr. W. Perrin Norris, Commonwealth Director of Quarantine, Melbourne, who took for his subject public health ideals. Section J, Mental Science and Education: the Rev. E. H. Sugden, whose address dealt with the place of music in education

During the meeting Prof. P. Marshall delivered a popular lecture in the great hall of the University on glaciers of the southern Alps; Dr. Mawson, of Adelaide, lectured on "Antarctica," with special reference to his forthcoming expedition; and Prof. T. H. Laby exhibited a working model of Brennan's mono-rail. Numerous social functions were arranged, including a garden-party to members of the association, given by Lord Chelmsford.

There are several committees of the association which are to continue to exist during the present year. Among these may be mentioned the Solar Eclipse 1910 Committee, appointed at Brisbane in 1909. In connection with the work of this committee, the local Council of New South Wales passed the following resolution:—"That the committee appointed at the Brisbane meeting in 1909 in connection with the solar eclipse of 1910 be asked to make such arrangements as may be necessary before the meeting of the association in January for the observation of the total solar eclipse of 1911 by Australian and other astronomers, and report to the meeting." It was announced during the meeting that the Federal Government had granted 500*l.* in aid of the solar eclipse expedition of this year. Other existing committees are those on solar research, terrestrial magnetism in Australia, seismology, alkaline rocks of Australia, glacial phenomena, geological and geo-physical phenomena, deep-sea dredging off the east coast of Australia, New Zealand food-fishes, and the biological and hydrographical study of the New Zealand coast.

RECENT ADVANCES AND PROBLEMS IN CHEMISTRY.

THE subjoined lecture was delivered by Prof. Emil Fischer, of the University of Berlin, on the occasion of the inauguration of the Kaiser-Wilhelm-Gesellschaft zur Förderung der Wissenschaften, in the presence of the German Emperor, on January 11, in the Ministry of Education at Berlin.

Prof. Fischer traces the relations between science and scientific industries in Germany, pointing out that by affording facilities for the prosecution of pure scientific research, technical industry can only gain.

If only this fact were practically realised in this country as it is in Germany, we should be spared the humiliation of seeing important technical branches of commerce, such as chemical industry, transferred soon after their initiation from England to the Continent.

Prof. Fischer in his address deals fully with this subject from the German point of view, so that it is unnecessary to refer to it here in detail; the remedy, however, lies entirely with the powers that be.

Your Majesty; Gentlemen,

At the present time, more than at any other period, we are inclined critically to examine the fundamental principles of all branches of knowledge, and, when necessary, to introduce far-reaching alterations in our original conclusions. This state of mind applies also to the natural sciences. During the last decades our actual knowledge has been extended to an extraordinary degree owing to new methods of research, and in view of the more recent observations the older theories have proved in many cases to be far too narrow. Even the fundamental principles of our knowledge appear, to a certain extent, to demand revision.

Thus the progress in physical science forces us to adopt views which are incompatible with the older principles of mechanics, in spite of the fact that these were regarded as unassailable by thinkers such as Hermann von Helmholtz, Heinrich Hertz, and Lord Kelvin.

We stand in the same position with respect to the elements in chemistry. Owing to the discovery of radium and similar bodies, we have been forced to the conclusion that chemical elements are not unalterable, and hence that their atoms are not indivisible.

The same state of affairs obtains to even a greater degree in the biological sciences. In comparative anatomy, animal and vegetable physiology, theory of evolution, microbiology, and almost all branches of medical science, the rapid advance of experimental knowledge is accompanied by an equally rapid change in established theories. Even the semi-historical sciences, such as geology, palæontology, anthropology, and the venerable science of astronomy, are taking active part in the general progress.

Thus in these times of general scientific activity is founded the Kaiser-Wilhelm-Gesellschaft zur Förderung der Wissenschaften, the primary object of which is the erection and maintenance of institutions of research.

It need scarcely be said that we scientific investigators welcome this new and highly specialised creation with intense satisfaction, and I regard it as a particular honour to be permitted to be the first to give expression of our profound gratitude.

No one will be able to assert that experimental research in Germany has been neglected; exactly the opposite conclusions must be drawn on contemplating the history of science during the nineteenth century. This displays a long series of brilliant scientific discoveries made in this country. The industries closely connected with science, such as the chemical and electrotechnical industries, fine mechanical engineering, production of metals, industries connected with fermentation, and last, but not least, agriculture, have also undergone in our hands a development envied on almost all sides by other nations.

Should a criterion of the results of experimental research be desired, this may perhaps be found in the distribution of the Nobel prizes, which are awarded by absolutely independent corporations in Sweden.

Only a month ago the Nobel prize for chemistry came

for the sixth time to Germany; this constitutes 60 per cent. of all the Nobel prizes hitherto awarded for chemistry. During the same period of time two and a half prizes were awarded to Germans for physics and three and a half for medicine. Dr. Alfred Nobel, unfortunately, did not provide for the remaining natural sciences.

The majority of the investigations distinguished by the award of these prizes, however, belong to the nineteenth century. Since that time matters are to some extent altered. It is well known that the greater number of German scientific investigators are teachers at universities or polytechnics. During the last ten years a scheme of practical education of the masses has developed, which affords to all students the possibility of acquiring a thorough training in experimental science, and which provides our industries with an army of scientifically educated workers. But this very education of the masses tends mentally to exhaust the teacher to a great extent, certainly to a higher degree than is desirable, or indeed compatible, with the creative power of the investigator.

There prevails in modern educational laboratories a condition of overstrained activity comparable with that existing in all but the smallest factories and commercial offices, and in the harassing cares of the day the teacher loses far too readily that peace of mind and broad view of scientific matters necessary for tackling the larger problems of research. This danger has been most keenly appreciated by teachers of chemistry, to which body I myself belong. It is therefore no mere accident that in our circles of recent years the cry for new laboratories should be at its loudest; an appeal for laboratories which should permit of research in absolute tranquillity, unencumbered by the duties of teaching.

But all our efforts were fruitless, in spite of the active support of an industry ready to make any sacrifice, and we were about to abandon, with reluctance and with sadness, our cherished plan, when the action of your Majesty in directing the attention of all munificent ladies and gentlemen in Germany to the need of supporting scientific research came to us like a heaven-sent aid.

In place of the one State-supported chemical institute which we had planned, chemists may now anticipate the immediate possession of two such institutes in which gifted men may conduct their original researches with ample means in freedom from any other duties. It is anticipated that the younger generation of chemists will thereby derive special benefit. By the younger generation I mean in particular those men who are at present acting as assistants or lecturers in university laboratories, and who can carry on research in addition to the servile labour of teaching only by possession of an extraordinary capacity for work.

That which applies to chemistry may, *mutatis mutandis*, be applied to the other sciences, and is especially applicable to new branches of knowledge, for the prosecution of which the laborious organisation of educational laboratories leaves no possibility.

The handicap under which we work, in comparison with other nations, in particular the United States of America, in which similar institutes have recently been founded, can thus be removed. If the hopes which we all place in the new institutes are fulfilled, Germany will in the future not lack recipients of Nobel prizes, and we may then hope to maintain the honourable position which we hitherto have held in the domain of science.

That this is, however, not only a matter of sentiment and honour, but a palpable advantage in material respects, is at once evident from the close relation between modern scientific progress and national well-being. I am not here to demonstrate this relation by means of statistics or political economical considerations. On the contrary, I would invite your attention to a cursory review of my own science. I shall thus, in considering the most recent achievements in this field, be able to point out to you the diversity of the problems and their fertility with regard to the most varying branches of technical industry.

As I have already remarked, our conception of the nature of chemical elements has to some extent altered owing to the discovery of radium, the first element to be discovered by a woman. We are now acquainted with more than twenty-four such substances—the so-called radio-active elements—and we recognise that they disintegrate spontaneously, and that elementary transmutations are hence possible.

Germany took at the outset only a small part in the notable researches connected with the discovery of these elements, although the first stimulus leading to the discovery of radio-activity was given by the Röntgen rays. The reason for this is that Germany possesses none of the raw materials necessary for the production of radium, and that the majority of German investigators have not the means for the purchase of this costly element. This lack of means was especially keenly felt when radium first found profitable application in the fields of medicine.

We are therefore all the more delighted to record such an event as the recent discovery due to Prof. Otto Hahn of the chemical laboratory of the University of Berlin.[1] He has for several years been investigating the disintegration products of thorium, which is employed in large quantities in the manufacture of incandescent mantles, and has in the course of his work discovered several radio-active elements, the most important of which he has designated mesothorium. He has, moreover, succeeded in devising a process for the isolation of this substance from the valueless waste products occurring in the manufacture of thorium I am therefore able to show to you a specimen of Hahn's preparation. This is the bromide of mesothorium, a white salt, which evolves the same highly penetrating rays as the corresponding salt of radium. In radio-active power this preparation is equivalent to 100 milligrams of pure radium bromide, but costs only one-third as much. Nevertheless, it is not cheap, since for this small quantity of material 550*l.* was paid. Thanks to an endowment from Dr. von Böttinger, of Elberfeld, the Akademie der Wissenschaften in this city will in a few months be in possession of 250 milligrams of this substance, and lend it out to German investigators. It would be possible yearly to produce in Germany a quantity of this preparation of Dr. Hahn's equivalent to more than 10 grams of pure radium bromide from the valueless residues after the extraction of the thorium. This is approximately equivalent to the world's stock of radium. By this discovery, the radium famine hitherto prevalent in Germany may be said to be relieved.

The field of chemical experimentation has in the last decade been widened to an extraordinary degree by the ease with which it is possible to obtain very high and very low temperatures. High temperatures can now be obtained by means of electric furnaces with which temperatures up to 3000° are easily produced. Low temperatures may be obtained by means of liquid air. This commodity can now be purchased in Berlin at the price of a wine of medium quality, that is to say, at 1*s.* 9*d.* per litre. For this we are indebted to your Majesty, who invited Prof. von Linde, of Munich, to erect here one of his large machines for the liquefaction of air.[2] You will understand how indispensable this liquid has become when I tell you that in the laboratories of the University of Berlin several litres are daily consumed for scientific purposes.

Far more effective is liquid hydrogen, which affords a temperature lying 60° below that of liquid air. The boiling point is so low as −252·6°, only 20·4° above the absolute zero. It cannot, however, yet be purchased in Berlin; in fact, it cannot be obtained here at all. I am nevertheless able to show it to you. This preparation comes from the physical laboratory of the University of Leipzig, where it was prepared this morning and transported here with some care. I will now transfer a small quantity from the oddly shaped container into a transparent glass vessel, and demonstrate the lowness of its temperature by immersing in it a glass tube sealed at the bottom. On removing the tube it is seen to be filled with a white solid resembling snow; this is solid air; you will see that, when once removed from the cooling liquid, this solid melts after a few moments.

The remainder of the liquid hydrogen in the containing vessel is to serve to-day for scientific purposes. At the end of my lecture it will find its way to the physical

[1] Dr. Hahn made the discovery of mesothorium in the laboratory of University College, London, while investigating some thorianite residues given to him by Sir William Ramsay.—Tr.

[2] A similar apparatus was independently devised and simultaneously patented by Dr. William Hampson in London.—Tr.

chemical laboratory of the University, there to be employed this evening and during the night by Prof. Nernst for his important researches on the specific heat of the elements at temperatures in the vicinity of the absolute zero.

When the Kaiser-Wilhelm Institutes for Chemistry are once in full swing, we shall, I hope, no longer be obliged to travel to Leipzig every time we want some liquid hydrogen.

Liquid hydrogen was prepared for the first time about twelve years ago by Prof. Dewar in the famous laboratory at the Royal Institution in London. But the costly experiments necessary for its production were rendered possible only by the liberal means which Dr. Ludwig Mond, the great benefactor of chemistry, placed at his disposal. Dr. Mond, moreover, has not forgotten his German Fatherland and German science. He bequeathed to the University of Heidelberg, where he had studied, the sum of 50,000*l.* for chemical and physical research, and several years ago he endowed the State-supported chemical institute which we had planned with the sum of 10,000*l.*

Inorganic chemistry, in which, thirty years ago, advance was scarcely considered possible, has, owing to the new aids to research—as, for example, high temperatures and powerful electric currents, &c.—undergone absolutely unexpected developments. I will merely give you some idea of this development by indicating a few processes of technical importance, beginning with the attempts to prepare valuable nitrogenous compounds from the nitrogen of the atmosphere.

The direct production of nitric acid from air [1] by means of a powerful electric discharge has reached the stage of large-scale manufacture. In Norway at the present moment a gigantic works, by the side of a mighty waterfall, is in course of erection by German factories in conjunction with Norwegian engineers, and supported by German and French capital.

Synthetical saltpetre is already on the market, and German dye factories derive a considerable portion of the nitrites necessary for their work from the same source.

The strikingly original process devised by Prof. A. Frank and Dr. N. Caro in Charlottenburg for the preparation of calcium cyanamide from calcium carbide and atmospheric nitrogen, came somewhat earlier into practice.

And now a third process, based upon the direct combination of atmospheric nitrogen with hydrogen to form ammonia, has been announced. Prof. Haber, of Karlsruhe, by means of an ingenious application of the laws of physical chemistry, has succeeded in obviating the difficulties which hitherto have rendered this synthesis impracticable. The well-known Badische Anilin- und Sodafabrik at Ludwigshafen-am-Rhein has taken over his patents and technically perfected the process to such a degree that synthetical ammonia will in all probability shortly be placed on the market.

The greater the number of such processes and the keener the competition which they excite, the greater is the benefit to the consumer. In the case I have just mentioned, this has an especial significance, as the bulk of technical nitrogenous substances are employed in agriculture for artificial manures.

In the opinion of high authorities, German agriculture could easily consume twice, nay thrice, the amount of nitrogenous material at present employed for this purpose, were only the price to fall to a corresponding degree. In such a case it is possible that the crops would increase to such an extent that Germany could be independent of foreign countries with respect to agricultural produce. A task of great national importance has thus been set to chemical industry.

This last process, the synthesis of ammonia, possesses the advantage that no electricity, merely heat, is involved. In other words, all that is necessary is fuel, a commodity of which Germany has ample store. Furthermore, it is to be noted that the cost of production depends only on the price of hydrogen, which, together with the inexpensive atmospheric nitrogen, serves as raw material. The problem of producing hydrogen at a moderate cost has already been solved by chemical industry, owing to the great interest recently taken in airships. In this way, the truth of the old saying is established—that all industries affect one another, and that improvements in one field may occasion fertile results in totally remote spheres of activity.

Such a relation of mutual stimulus obtains also between theoretical chemistry and the production of metals. The production of gold, silver, and copper has gained in simplicity to an extraordinary degree by the introduction of electrochemical methods. The study, moreover, of alloys, and the perfecting of inexpensive methods of preparing metals hitherto obtainable only with difficulty, such as chromium, tungsten, manganese, vanadium, and tantalum, has been of immense benefit to the steel and electrotechnical industries.

Not to omit the latest productions of these industries, I here show you a new sort of iron, the so-called "electrolytic iron." This is prepared by the Langbein-Pfannhauser factory in Leipzig by a process devised by Prof. Franz Fischer in the laboratories of the University of Berlin, in which process the iron is deposited from a solution of an iron salt by an electric current. You see it before you in the form of extremely tough plates, reaching a thickness of 5 mm., which may readily be rolled or drawn into wire. The bright surface is not due to any polishing, the metal being detached in this state from the electrode. Here you see a seamless iron tube coiled in serpentine fashion, which was deposited in the same way upon a leaden core.

This iron is distinguished from all other commercial varieties of iron by its extraordinary purity, in consequence of which it possesses distinctive physical properties. In particular, it is much more readily magnetised, and loses its magnetism far more rapidly than other kinds of iron, this property rendering it especially suitable for electromagnets. This electromotor before you, of ordinary design, formerly developed 0·5 horse-power, but on replacing the original electromagnets by those constructed of electrolytic iron, the efficiency has risen to 1·25 horse-power. This new iron should therefore be of the greatest importance in the construction of electromotors.

Our present-day material civilisation is to a great extent founded on the rapid utilisation of the fossilised combustibles anthracite and brown coal. But posterity will not fail to reproach us with having grievously squandered this valuable material, for in the conversion of the heat of combustion of coal into energy in the ordinary way by means of steam engines, more than 85 per cent. of the work potentially contained in the coal is lost. This loss, however, may be appreciably lessened by suitable chemical treatment of the coal. If the coal be first converted into combustible gas—so-called power gas—and this then consumed in a gas engine, the output of useful power is treble that developed in a steam engine. Valuable bye-products—ammonia and tar—can, moreover, be recovered, and, indeed, the methods hitherto employed for the production of power gas are in many respects capable of improvement. I therefore deem it possible that at some time special institutes will be founded in the centres of the coal districts—perhaps under the auspices of the Kaiser-Wilhelm-Gesellschaft—where these important problems can be investigated with the aid of all the methods known to science.

Fossilised combustibles, which owe their origin to the vegetable kingdom, form a connecting link between mineral and organic substances. Organic chemistry surpasses inorganic chemistry in variety of methods and products to the highest degree. Small wonder, for it embraces all those complicated chemical bodies which occur in animal and vegetable life. The number of organic substances accurately investigated may to-day be estimated at the huge figure of 150,000, and every year eight or nine thousand more are added to the list. We may therefore reckon that at the close of this century organic chemistry will comprise the entire gamut of substances found in the animal and vegetable kingdoms.

This rapid increase is wholly due to organic synthesis. From the few elements occurring in organic chemistry, of which carbon predominates, all these compounds are built up, much as an architect produces the most diverse edifices from the same form of brick.

Synthesis in organic chemistry is an offspring of Berlin. It was born eighty-two years ago in the Niederwallstrasse by the synthetical production of urea by Friedrich Wöhler. It has, moreover, found its greatest field of

[1] First carried out on a moderately large scale by Lord Rayleigh (Trans. Chem. Soc., 1897, lxxi., 181).—Tr.

activity in Germany. It stands no longer in fear and trembling of the complicated constituents of the living organism. I shall demonstrate this fact by discussing the three classes of substance predominating in organic life: the fats, the carbohydrates, and the proteins. The synthesis of fats was effected so far back as two generations ago by M. Berthelot in Paris. The first synthetical carbohydrates—grape sugar, fruit sugar, &c.—saw the light twenty years ago in Würzburg; and the methods for the synthetical building up of albuminous substances have been worked out during the last ten years in the laboratory of the University of this city. I am therefore able to show you one of these products. It is the most complicated substance ever evolved by synthesis, and has so long a name that I do not venture to pronounce it here. The amount is certainly small, and, as you will perceive later, the beakers and flasks of the scientific investigator are minute when compared with the vats employed by the chemical manufacturer. This relative difference in size is also borne out by the comparative wealth of these two classes of men. This synthetical protein, like the preparation of Dr. Hahn, is anything but cheap. The starting materials for its synthesis cost about 50*l*., and the labour involved in its preparation must be estimated at even a higher figure. It has therefore not as yet made its appearance on the dining-table. It is, in fact, nothing but a chemical curiosity. But you must bear in mind that what is to-day a curiosity may to-morrow be of the greatest value. Chemistry affords numberless illustrations of this statement.

Through such things as these proteins, carbohydrates, and fats, organic chemistry is brought into close touch with the biological sciences; for the entire metabolism in the living organism is merely a sequence of chemical transformations which these substances undergo. Chemistry is thus called upon to partake in the solution of the great riddles of life: nourishment, growth, reproduction, heredity, age, and the manifold pathological disturbances of the normal state. It is not surprising that the keenest activity exists in these interesting fields of work, and we may safely hope that provision will be made for biological research in the new Kaiser-Wilhelm institutes.

The example given by the magnificent institute here in Berlin for the study of the problems of the industries connected with fermentation, in which the results of scientific research meet the practical requirements of brewers and distillers, serves to show how fruitful can be the collaboration of biologists and chemists. This institute has contributed its share to the small exhibition here this evening by a series of beautiful mould cultures and yeast preparations.

Moreover, chemical and many other industries have derived great benefit from organic chemistry. A few examples from recent times will illustrate this fact.

The most widely distributed of all the carbohydrates is cellulose, of which cotton and linen are entirely composed, and which is the chief constituent of wood and plant fibres. And what a variety of articles is nowadays manufactured from cellulose! Paper, collodion, celluloid, photographic films, smokeless powder, artificial silk, artificial hair, artificial leather.

Paper, in this era of paper, is not a substance which justifies its exhibition here; the same may be said of celluloid and collodion. I have not brought here samples of smokeless powder and the other high explosives derived from cellulose, as the Ministry of Education seems a place far too peaceful for their exhibition. But you see before you artificial silk and horse-hair and films in diverse and magnificent array. These come from the works of Fürst Guido von Donnersmarck; and not to omit mention of his competitors, I here show you some photographic films, manufactured by the Berlin Anilinfabrik, which, unlike the ordinary variety, burn only with the greatest difficulty. All these products have been prepared by ingenious combinations of chemical and mechanical processes. To dispel any false impression, I must tell you that artificial silk and hair, in spite of their striking similarity, are of totally different composition from the natural products, which are not derived from cellulose, but belong to the class of proteins.

The magnificent colours[1] with which these artificial textures are so beautifully dyed are, of course, the work of organic chemistry. These belong to the family of synthetical coal-tar dyes. This subject is to-day so large that complete half-yearly courses of lectures are delivered upon it at the universities. Hundreds of such dyes are on the market, and the value of the dyestuffs produced in Germany, the majority of which are exported, approximates to fifteen millions of pounds sterling.

Of all these dyes I shall only mention synthetical indigo, because this substance was the most difficult of all to synthesise, and on the other hand was a great commercial success. This beautiful crystalline preparation, purified by sublimation, hails from the Badische Anilin- und Soda-fabrik. It is also manufactured by the dye factory at Höchst-am-Main.

This synthetical product is not only much purer in composition and colour than the natural dyestuff, but also considerably less expensive. On this account, the cultivation of the indigo plant in India has diminished to one-sixth of the original extent, and will, to all appearances, soon disappear altogether.[1] Woollen and cotton goods are now dyed with German indigo even in Asia, to which continent a quantity of indigo worth no less than 1,900,000*l*. was exported in the year 1909.

While on this subject, I may refer to the two most important colouring matters of animal and vegetable life, chlorophyll and hæmoglobin. The former plays an important part in the chemical process upon which all life depends—I refer to the conversion of the atmospheric carbon dioxide into sugar, which takes place in green leaves under the influence of sunlight. The red pigment in the blood fulfils in our own bodies the important function of transporting the oxygen from our lungs to the tissues, thus rendering possible that process of combustion which forms the basis of our bodily and mental strength.

I here show to you two specimens of pure chlorophyll, one of which is crystalline. I owe these rare preparations to Prof. R. Willstätter, of Zürich, who of recent years has been studying this colouring matter with remarkably successful results. Hæmoglobin has also lately been thoroughly investigated in Stuttgart and in Munich, and the remarkable conclusion has been drawn from these investigations that chlorophyll and hæmoglobin are closely related. This fact thus denotes a species of consanguinity between the animal and vegetable kingdoms. This must, however, be of great antiquity—that is to say, to date from remote times, when the animal and vegetable kingdoms were as yet not distinct.

Of greater commercial importance than the coal-tar dyes is indiarubber. Its consumption is continually increasing, and is estimated at some 70,000 tons yearly, an amount corresponding in price to about thirty-five millions of pounds. You can therefore readily understand that this subject has attracted the attention of synthetic chemists, and for the last nine months one has heard, even in public, of attempts to prepare synthetical indiarubber. In fact, in August, 1909, Dr. F. Hofmann and Dr. C. Coutelle, chemists to the Elberfelder Farbenfabrik, succeeded in devising a practical process for its synthesis. The starting material is a volatile, mobile, and colourless liquid termed isoprene,[2] which in turn can be readily synthesised from even simpler substances.

This liquid is converted into indiarubber merely on heating in closed vessels. Here you see a sealed glass tube which was originally filled with this mobile liquid isoprene, but now, after heating, contains a jelly-like mass of synthetical indiarubber. When thus prepared on a large scale, it is somewhat denser and of a light yellow colour, as you see from this preparation. That this product is really indiarubber has been definitely established by the scientific investigations of Prof. Harries in Kiel, a high authority on this subject, who has since independently devised another process for the same purpose.

When synthetic chemistry has once taken possession of such a field, it is not confined to the particular product

[1] The first, "mauvine," was prepared by the late Sir William Perkin in the year 1856 and manufactured at Greenford.—Tr.

[1] The recent work of Bloxam and his collaborators has demonstrated the possibility of recovering from the leaf a yield of indigo increased to such a degree that the cost of production is certainly no more than that of the synthetical product. Furthermore, the natural indigo is stated by some authorities to possess certain benign impurities which render it more suitable for dyeing purposes.—Tr.

[2] First shown to yield indiarubber in 1892 by Sir William Tilden (*Chem. News*, lxv., 265).—Tr.

occurring in nature, but can bring forth a whole series of similar substances. You will therefore not be surprised when I show you other rubber-like substances which have been prepared, not from isoprene, but from similar liquids, such as dimethylbutadiene. Such products are termed homologues. They possess properties closely resembling those of indiarubber, but differ slightly in chemical constitution. It is, as yet, not decided which of these synthetical substances forms the most suitable substitute for indiarubber. The same applies to the far more important question of cost of production. But when one considers the fate of natural indigo, of madder, and of other natural products, one may hope to see synthetical indiarubber gradually enter into successful competition with the naturally occurring commodity.

Camphor, which may be placed in the same chemical category as indiarubber, is also prepared artificially on a large scale. The first firm to manufacture synthetical camphor was the Chemische Fabrik auf Aktien (formerly Schering), of Berlin, but other firms are now following suit. By this, the camphor monopoly, which the Japanese Government was able to establish after the annexation of Formosa, was broken down.

Here you see an artificial resin which closely resembles amber in its external characteristics, and which, as these necklaces, combs, cigar-holders, &c., show, can be employed as a substitute therefor. These articles have been placed at my disposal by the Bakelite Company of this city, Bakelite being the trade name of this substance. It is prepared from constituents of coal-tar by a process which, although long known, has been technically worked out by the American chemist Baekeland.[1]

Synthetic chemistry, in close association with medicine, is actively engaged in pursuit of the discovery of new medicaments. The great amplitude of this subject again compels me to mention only a few instances.

In this bottle you see a white powder—veronal—which is a hypnotic largely employed at the present day. It is in no way connected with the older vegetable narcotics—opium, &c.—but is entirely a synthetical product. One-tenth of this quantity would suffice to send this entire gathering into a peaceful slumber. But should the mere demonstration of this soporific—coupled with this lecture of mine—take effect on any susceptible persons present, there is no better remedy than the cup of tea which we are to enjoy later, for tea contains a chemical substance which stimulates the heart and nervous system. This is also present in coffee, in which it was discovered ninety years ago by Runge in this country. The humorously inclined discoverer gave to it the name of "Kaffeebase," which, however, was afterwards changed to the more aristocratic "caffein." It is an odd coincidence that caffein was first synthesised in the laboratory of the University of Berlin exactly fifteen years ago. This synthesis has led to its manufacture on a large scale. In this bottle you see a specimen of synthetical caffein, manufactured by the firm of Messrs. C. F. Böhringer and Sons, in Mannheim. It is prepared in large quantity from uric acid, a constituent of guano, but has undergone such a complete chemical transformation and purification that it no longer possesses the unpleasant characteristics of the raw material from which it is manufactured. The chemist may therefore apply to such substances the remark made by the Emperor Vespasian concerning the tax-money which came to him from an unclean source: *non olet* (it does not smell).

Pure caffein is at present employed only as a medicament, though, indeed, in considerable quantity. But it finds, of course, a far greater application in the form of the active principle in tea, coffee, kola, and Paraguay tea (maté), so that after alcohol it is certainly the most widely employed stimulant. So soon as organic chemistry succeeds in the entirely possible task of synthetically reproducing the aroma of tea and coffee, there will be nothing to hinder the artificial preparation of these beverages; and when the Minister of Education invites to tea a gathering to celebrate the fiftieth anniversary of the Kaiser-Wilhelm-Gesellschaft, the repast, I hope, will consist of synthetical tea.

Organic synthesis is not limited to vegetable products only, but embraces equally fearlessly substances of animal origin. An instructive example of this may be found in a remarkable compound (adrenalin) which is formed in our own bodies in the suprarenal glands, and which plays an important part in the regulation of the blood pressure. Shortly after its isolation in a pure condition from these glands, Dr. F. Stolz, chemist to the dye factory at Höchst, was able to synthesise it from constituents of coal-tar. This synthetical product has now been placed on the market by the Höchst firm under the name of "Suprarenin." A very dilute solution of this substance causes a powerful contraction of the blood vessels, and consequent dispersal of blood from the tissues. A skin surface well charged with blood—as, for instance, a red nose—is instantly rendered quite pale on painting it with such a solution. Unfortunately, the colour is not evenly discharged, owing to the varying permeability of the epidermis, and as the action of the drug soon ceases, with return of the original redness, adrenalin is not suitable as a cosmetic. On the other hand, it finds most useful application in surgery, as by its means certain incisions can be made without loss of blood; this is found particularly convenient for operations on the eye, mouth, and nose.

The factory in Höchst, which has placed at my disposa this preparation in the numerous forms which you see before you, has also contributed several samples of the new arsenical remedy originally known as "Ehrlich-Hata," but now as "Salvarsan." If you are desirous of knowing more about it, I must refer you to the more authoritative knowledge of the discoverer, Prof. Ehrlich, who is at present in our midst.

Flora's fairest children, the sweet-scented flowers, must also submit to competition with synthetic chemistry. The scent industry has received a powerful impetus from synthesis, and yearly turns out in Germany alone goods of the value of more than two million pounds. I shall here show you only a few of the numerous products. This bottle contains ionone, an artificial violet-scent discovered in the laboratory of this University by the late Prof. F. Tiemann, and manufactured by Messrs. Haarmann and Reimer in Holzminden. The contents of this bottle would be sufficient to envelop, not only the Ministry of Education, but the entire avenue "Unter den Linden" in an atmosphere of violet perfume, for the osmophoric value of these substances is extraordinarily high.

In contradistinction to the simple ionone, the majority of the natural odours of flowers are due to complex mixtures of different scents. These, nevertheless, have been successfully reproduced. Among the scents here displayed are lily-of-the-valley, mock-orange, lilac, tuberose, and, finally, the greatest achievement, synthetical attar of roses. Although the natural oil from roses contains about twenty different odorous substances, the chemists of the scent factories at Leipzig (Heine and Co., Schimmel and Co.) have succeeded after laborious research in isolating all the components, synthesising these, or preparing them from less costly oils, and then reuniting them in the proper proportions. It now requires a most sensitive nose indeed to distinguish the synthetical attar of roses from the natural product.

I only hope that the noble patroness of roses, her Majesty the Empress, will not take amiss this intrusion of chemical synthesis upon the monopoly hitherto held by her favourite flowers. Perhaps she will regard it more favourably if your Majesty will be so kind as to present this synthetical product to her Majesty as a humble offering from chemical industry.

These examples show the success which has followed the encroachment of synthetic organic chemistry in nature's domain. What I have already said is sufficient to prove that chemistry, as well as all natural sciences, is the true field of unlimited possibility. The Kaiser-Wilhelm institutes are henceforth to take part in the expansion of this field and the appropriation of the treasures hidden therein.

It is, of course, not to be expected that they will entirely supplant all the older scientific institutions. We of the older institutions do not feel by any means so weak as willingly to allow such an event to occur. On the contrary, we shall exert our best energies to maintain a keen competition with the younger institutes. This will serve to keep both sides fresh and active.

[1] A similar process for the manufacture of this substance was independently developed and patented in England by Story (Brit. Pat., 1905, 8875).—Tr.

But there can be no doubt that these godchildren of the German Emperor will in the healthy air of the Grunewald soon develop great strength from the liberal nutrition supplied by their patrons, and grow up into renowned centres of research.

We may therefore confidently hope that in later years the foundation to-day of the Kaiser-Wilhelm-Gesellschaft will be regarded as an unmixed blessing to scientific research in Germany.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—It is proposed to alter the regulations for the diploma of agriculture so as to ensure that agricultural physiology shall be one of the compulsory subjects for part ii. of the diploma examination. It is also proposed to abandon the present method of grouping the subjects, and that in part i. of the diploma examination a candidate who has obtained honours in the natural sciences tripos shall be excused chemistry if he has passed chemistry in the tripos, botany if he has passed botany in the tripos, and zoology if he has passed either zoology or physiology.

MR. H. MAXWELL-LEFROY, Imperial entomologist for India, will give the inaugural lecture of his course on entomology at the Imperial College of Science and Technology on Thursday, March 2, at 5 p.m.

PROF. V. H. BLACKMAN, who since 1907 has occupied the chair of botany in the University of Leeds, has been appointed to the professorship of plant physiology and pathology at the Imperial College of Science and Technology at South Kensington. He will take up his new duties at the beginning of July.

ON several occasions we have directed attention to the useful work done by Prof. Perry, F.R.S., through his system of bursaries, which he established at the Royal College of Science in 1902 with a contribution of 100*l.* from the Drapers' Company. The bursary fund was established particularly for the benefit of national scholars, but the scholarships held by these students have now been increased in value sufficiently to render Prof. Perry's bursary fund unnecessary. A final balance-sheet dealing with the period between July 17, 1908, and January 24 of the present year, has been published in the current issue of *The Phoenix*, the magazine of the Royal College of Science and Royal School of Mines. During the years since Prof. Perry inaugurated the scheme, the sum of more than 1600*l.* has been disbursed to students needing judicious assistance in a tactful way. We have reason to know that it is seldom that such a sum of money is spent with so great an advantage to the beneficiaries.

THE successful students of the City and Guilds of London Institute received their prizes from the Lady Mayoress at the Mansion House on February 17. On this occasion the honorary secretary of the college, Sir John Watney, announced that the name of the City and Guilds Central Technical College will be changed to the City and Guilds Engineering College, and as such will constitute the engineering department of the Imperial College. It will be managed by a delegation representing the City and Guilds Institute, the Imperial College, and the Goldsmiths' Company. After the distribution of prizes, Dr. R. T. Glazebrook, F.R.S., director of the National Physical Laboratory, delivered an address on the interdependence of science and industry. He said the agencies at work in London applying science to the wants of industry included the university colleges, the polytechnics, and the technical schools. He asked, Is it not possible to conceive some scheme by which the labours of such agencies can be coordinated and linked up with the Imperial College as a centre where the staff and students will be free to conduct original investigations, and, through these, to learn new truths? Under such a scheme the Imperial College would become, first, the Central Technological University for London, and then for the Empire. A body like its governing body, modified so as to include representatives of the other institutions, forming with it the technological side of the University in London, would become the council of the faculty. He put forward the following propositions:—(1) that a combination of the technological departments of existing institutions and schools into an independent technological faculty is necessary; (2) that in such a faculty a definite value should be given to technical education in each London school; and (3) that the technological faculty should confer degrees under conditions to be laid down by the faculty.

IN the French Chamber of Deputies on February 16, M. Maurice Faure, Minister of Public Instruction, summed up the discussion on the estimates for his department. From the report by the Paris correspondent of *The Times*, we learn that, with reference to higher education, M. Maurice Faure said that the French universities, which are autonomous, thanks to the legislation of 1896, and have been endowed by the State with foundations amounting to more than 1,000,000*l.*, are keeping pace with modern requirements, and are extending their influence abroad as well as at home. New laboratories are being erected by the Sorbonne in the Rue Saint Jacques, the University of Nancy has opened an electrotechnical institute, at Grenoble there is now a new paper-making school, at Lyons a new chemistry school, at Lille various new mining courses, at Dijon an agricultural and œnological institute, and fresh technical subjects have been introduced into the curriculum at Toulouse, Caen, Rennes, and elsewhere. Foreign students are being attracted in increasing numbers, and abroad there have been established French institutes at Florence and at Madrid, which are respectively affiliated to the University of Grenoble and to those of Bordeaux, Toulouse, and Montpellier. The foundation of similar institutes is contemplated at St. Petersburg under the auspices of the Sorbonne, and at Constantinople under the auspices of the University and City of Lyons. The creation of a chair of colonial history in Paris has been proposed by the Budget committee, and the faculty of medicine is to be asked to consider a proposal in favour of the foundation of a chair of climatology and mineral hydrology, the cost of which the various French spas and watering-places have offered to defray. In the secondary schools, the paramount claims of purely scientific studies has been recognised in accordance with modern requirements.

THE third annual meeting of the Old Students Association of the Royal College of Science, London, was held at the college last Saturday, the president, Sir Thomas H. Holland, F.R.S., presiding. Sir Alexander Pedler, F.R.S., was elected president for 1911, and Mr. T. Ll. Humberstone and Mr. A. T. Simmons were re-elected secretary and treasurer respectively. A draft report, prepared by a special committee, for the Royal Commission on University Education in London, was considered and adopted. In the evening, the third dinner of old students was held at the Criterion Restaurant, about ninety being present. Prof. Edgeworth David, F.R.S., an old student of the college, in proposing the toast of the Royal College of Science, referred to the request of the association for the representation of old students on the governing body of the college. It was, he said, the academic thing to do, for no one could better appreciate the needs of a college than the men and women who had graduated there. The principle was recognised throughout the universities of the world, and had been adopted with marked success in his own University of Sydney. Mr. William Burton, in replying to the toast, expressed the hope that better provision would in the future be made for the financial and social needs of the scholars attending the college. The chairman, Sir Thomas Holland, in responding to the toast of the Old Students Association, proposed by Mr. G. T. Holloway, referred to the adoption of an academic costume for associates, which, he said, secured the definite recognition of the college. But, in maintaining the rights of the college and the interests of the association, he urged old students not to forget that they belonged to a larger college in which other interests were represented. The association were indebted to their governors for the sympathetic way in which they had met the demands of members. Sir Alexander Pedler, F.R.S., the new president of the association, proposed the toast of the Guests, for whom Dr. A. D. Waller, F.R.S., replied.

IN reply to a question in the House of Commons last week, the Home Secretary stated that the Pharmaceutical

Society is considering certain questions connected with the educational curriculum of pharmaceutical chemists and of chemists and druggists with the view of framing bye-lays in pursuance of the powers vested in them by the Poisons and Pharmacy Act, 1908. At the present time, candidates for the qualifying examination in pharmacy are not required to undergo a systematic course of instruction, and it is no part of the duty of the society to inquire how or where they were educated. In the absence of a compulsory curriculum, "cramming" is very prevalent in connection with this examination, the result being a high percentage of failures. Thus last year, out of 1027 candidates who entered for the examination, 620 were unsuccessful. Before actually proceeding to frame bye-laws, the council of the society has drafted a scheme, which has been submitted to pharmaceutical associations in all parts of the country and to the principals of schools of pharmacy, with the object of eliciting expressions of opinion on the matter. The draft scheme suggests that the examination be divided into two parts, and that a candidate desiring to enter for the intermediate examination shall produce evidence that, subsequent to passing the preliminary examination and being registered as a student, he has attended, in a teaching institution approved by the council, not fewer than 50 lectures in botany, 100 lectures in chemistry, and 25 lectures in physics, and has done 25 hours' work in practical botany and 300 hours' work in practical chemistry. As to the final examination, it is proposed to require candidates—who must have been engaged for three years in the ordinary work of pharmacy under the supervision of a pharmacist—to produce evidence of having attended at a recognised institution 60 lectures and demonstrations in materia medica, 30 lectures in pharmacy, and 20 lectures in dispensing and prescription Latin. and of having done 200 hours' work in practical pharmacy and 100 hours' work in practical dispensing. The proposals have already been discussed by a number of pharmacists' associations, and divergent opinions have been expressed. While some are in favour of adopting the scheme, others are pressing more especially for a modification of that part of the proposed curriculum which precedes the intermediate examination, and the council is being urged to consider the advisability of accepting the certificates of other examining bodies in lieu of the intermediate examination.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 16.—Sir Archibald Geikie, K.C.B., president, in the chair.—W. **Rosenhain** and S. L. **Archbutt**: The constitution of the alloys of aluminium and zinc. In connection with researches on light alloys, carried out on behalf of the Alloys Research Committee of the Institution of Mechanical Engineers, the authors have studied the constitution of the Al-Zn alloys by pyrometric and microscopic methods, including the study of specimens after prolonged annealing at definite temperatures and after quenching. The results are represented in an equilibrium diagram differing materially from those previously put forward. The principal points of difference are:—(1) The liquidus curve shows a small break at a concentration of 85 per cent. of zinc, this break being connected with the formation of a definite compound of probable formula Al_2Zn_3. (2) In alloys under conditions of complete equilibrium the occurrence of eutectic ceases at a concentration of about 78 per cent. of zinc, although in ordinary slowly cooled alloys the eutectic can be traced down to the vicinity of 50 per cent. zinc. (3) At a concentration of about 78 per cent. of zinc, the solidus curve of the alloys rises abruptly from the eutectic line (380° C.) to a horizontal line of arrest points at 443° C. This line commences at the break in the liquidus curve already mentioned, and extends to about 37 per cent. of zinc; between 78 and 40 per cent. this line represents the solidus, but near 40 per cent. the solidus bends upwards towards the melting point of pure aluminium. The reaction indicated by this line of arrest points is the formation of a compound (Al_2Zn_3) by the reaction of crystals of a solid solution of zinc in aluminium with the residual liquid. (4) A second horizontal line of arrest points of considerable intensity has been found at 256° C. in alloys containing 99 to 35 per cent. of zinc. These heat evolutions are due to decomposition of the compound (Al_2Zn_3) into two phases, one of which is the saturated solid solution of Zn in Al, while the other is practically pure Zn. (5) The existence of a definite compound is indicated, stable only between 443° C. and 256° C., and having a zinc content of about 78 per cent., most nearly represented by Al_2Zn_3. Evidence for its existence is derived from the termination of the eutectic line and the position of maximum intensity of the line of heat evolutions just mentioned; this is strikingly confirmed by the micro-structures, which show the compound in the form of characteristic hexagonal dendrites. When decomposed (at or below 256° C.), it exhibits a duplex laminated "pearlitic" structure strikingly resembling the pearlite of carbon steel.—R. **Whiddington**: The production and properties of soft Röntgen radiation. Röntgen rays from ordinary bulbs are usually produced at generating potentials of between 10,000 and 100,000 volts. It is possible by using a special tube with a very thin aluminium window to experiment with rays generated at only a few hundred volts. The rays dealt with in this paper were generated at 1000 to 3600 volts. It has been found that such soft Röntgen rays have much the same properties as the harder rays usually experimented with. They produce ionisation in air, affect photographic plates, and can excite secondary radiations when incident on solid bodies. Their range in air, however, is not many centimetres. For many purposes a Röntgen radiation is sufficiently defined by a knowledge of (1) the total energy; (2) the penetrating powers in absorbing screens. These two properties have therefore been investigated in some detail, with reference particularly to the influence exerted by (1) the material of the antikathode; (2) the potential at which the rays are generated. The antikathodes used fall naturally into two groupings:—Group A.—Al, Pt. Group B.—Ag, Cd, Cu, Fe, Ni, Pb, Sb, Sn, Zn. The antikathodes of Group A emit secondary radiations, those of Group B do not. Experiment indicates that Al emits a soft characteristic radiation of λ/ρ 580 (in Al). In order to arrive at a common explanation of a number of experimental results, it is suggested that this Al radiation disobeys the law of "Röntgen ray fluorescence" recently advanced by Barkla.—Prof. J. **Eustice**: Experiments on stream-line motion in curved pipes. In a paper on the flow of water in curved pipes, the author has shown that during the flow of water through a pipe, if a change is made from a straight to a very slightly curved form, there is an increased resistance to flow, which is very marked at velocities below the critical velocity. In order to find the cause of the increase in resistance, an apparatus was designed which provides for the distribution of six variously coloured filaments of dyed water into a glass pipe through which water is flowing. The positions of the filaments can be so arranged that in the passage of water from a straight to a curved pipe the directions of the stream-lines in any part of the tube can be investigated. The experiments show that the curvature of a filament is less than the curvature of that part of the pipe in which the filament is flowing, and if the velocity of flow increases the curvature of the filament increases. The filaments impinge on the outer wall of the pipe, and, flattening into bands, follow the surface of the pipe and cross over to the inner wall, where the filaments start again in their path along the main stream, until (if the pipe is sufficiently long) the filaments again meet the outer wall, when the return flow along the surface is repeated. A filament flowing in the central plane of the pipe, when reaching the outer wall, divides into two parts, which come together on the inner wall of the pipe; the other filaments flow through the loop which is thus formed. A filament not in the central plane remains on that side of the plane in which it enters the curved pipe. The experiments were extended to angle pipes, and the velocities were increased until turbulent motion was obtained. After flowing through a curved pipe or angle, vortices are generated which persist in a contiguous straight pipe.

Challenger Society, January 25.—Dr. G. H. Fowler in the chair.—Commander Campbell **Hepworth**: Remarkable displays of phosphorescence in the sea. These displays took the form of rapidly moving curved bands of lumin-

escence, separated by dark or non-luminous bands: they appeared to radiate from a centre on the horizon, round which they seemed to rotate with increasing brilliancy and velocity. In one case they overtook the ship. The writer attributed them to the stimulation of phosphorescent organisms by tide-ripplings.—G. P. **Farran**: The breeding seasons of *Calanus finmarchius*. Though found over much of the North Atlantic, the species is only abundant shoreward of the isohaline of 35·25 per mille. In the end of the year a small stock, consisting of the penultimate stage V is found. In early March maturity has been attained and rapid reproduction sets in. By May immense shoals are formed, consisting mostly of the youngest stages, but with some adults. Reproduction slackens gradually, and by November has ceased.

Royal Meteorological Society, February 15.—Dr. H. N. Dickson, president, in the chair.—R. **Cooke** and S. C. **Russell**: Variation of the depth of water in a well at Detling, near Maidstone, compared with the rainfall 1885–1909. This well is on the chalk formation at the foot of the range of the North Downs, 358 feet above sea-level; its present depth is 118 feet. Weekly plumbings of the water in the well have been taken without interruption since 1885, and the authors have compared these plumbings with the rainfall of the previous week. The extreme variation of the water-level during the whole period was 30 feet 3 inches. Successive weeks of steady rainfall exercise a far greater effect upon raising the water-level than weeks of heavy but intermittent rainfall. As a rule, the effect of the autumn rains is not felt on the well until the month of December, but the winter rainfall penetrates most readily. Following a series of wet years, a high limit of saturation is attained; and once this condition is thoroughly established, the water remains at an almost constant level throughout the seasons, excess or deficiency of rain causing very little effect.—A. W. **Clayden**: The actinograph—a new instrument for observing and recording changes in radiation.—K. M. **Clark**: New set of cloudiness charts for the United States.

EDINBURGH.

Royal Society, January 23.—Prof. J. C. Ewart, F.R.S., vice-president, in the chair.—James **Ritchie**: An entoproctan polyzoon (*Barentsia benedeni*) new to the British fauna, with remarks on related species. An account was given of the minute structure of individuals attributed to this species, colonies of which, obtained at Hull, were kept alive under observation for some time. The later development and the various forms of this and related species were described, and the conclusion was arrived at that a redundancy of species and of genera had been established among the entoproctan polyzoa. Some of these the author proposed to suppress.—The following three papers were from the Physiological Department of Glasgow University:—(1) Adam **Black**: A study of artificial pyrexia produced by tetrahydro-β-naphthylamine hydrochloride. Experiments on rabbits were given to show that the fall of temperature produced by ether anæsthesia was largely due to increased loss of heat, and that it was prevented if the loss of heat were checked. It was then shown that the ether prevented the development of pyrexia under the drug, the conclusion being that the drug acted largely by causing contraction of cutaneous vessels, and thus decreasing heat loss. The changes in the protein metabolism under the drug were studied in the dog, and it was found that the disturbance was small in comparison with the disturbance produced by fever-producing toxins. (2) Dr. Janie Hamilton **M'Ilroy**: The independence of the peripheral neurons of the retina. The nature of the neurons having been considered, the results of a series of experiments upon section of the optic nerve upon these neurons were described, and it was shown that the peripheral neurons having their cells in the inner and outer nuclear layers preserve their integrity for at least nine months after section of the nerve. On the other hand, another series of experiments showed that in aseptic autolysis these peripheral neurons disintegrated rapidly and at an earlier date than the neurons of the ganglionic layer. —(3) Dr. Williamina **Abel**: A description of the cerebral cortex of the guinea-pig. The histological examination of the cerebral cortex showed the presence of five types of cerebral lamination. The area, in which the lamination indicated a motor type of cortex, lay in the posterior half of the cerebrum, and was surrounded by sensory zones. Electrical stimulation supported the conclusion come to through histological investigation as to the position of this motor area. Consideration was given as to the significance of this special type of cerebral topography.

PARIS.

Academy of Sciences, February 15.—M. Armand Gautier in the chair.—C. **Guichard**: The deformation of quadrics. —M. **Gouy**: The periodic structure of the magnetokathode rays. A further investigation of the fringes described in an earlier paper. A reproduction of a photograph of a set of fringes is given. According to the electron hypothesis of these phenomena, the figures described would be the caustics of the trajectories of the electrons, and the experimental results are not inconsistent with this view.—Lecoq **de Boisbaudran**: The dehydration of salts. It has been stated that there are no examples of salts, containing more than one molecule of water of crystallisation, losing a single molecule of water to form a lower hydrate. Examples are given from the sulphates of copper, iron, cobalt, magnesium, zinc, and nickel disproving this statement.—Paul **Sabatier** and A. **Mailhe**: Direct esterification by catalysis. The preparation of benzoic esters. If a solution of benzoic acid in an alcohol is vapourised, and the vapours passed over a column of oxide of thorium heated to 350° C., a nearly quantitative yield of the corresponding benzoic ester is obtained. The benzoates of ethyl, propyl, isobutyl, isoamyl, and allyl have been prepared in this manner.—C. E. Guillaume was elected a correspondant for the section of physics in the place of M. Van der Waals, elected foreign associate.—Paul **Dienes**: Series of polynomials and the singularities of analytical functions.—N. **Saltykow**: The theory of characteristics and its applications.—Pierre **Weiss**: The magnitude of magneton deduced from the coefficients of magnetisation of solutions of iron salts. The mean figure, 1122·1, is practically identical with the 1123·5 deduced from experiments made at Leyden on the metals themselves in liquid hydrogen.—A. **Hanriot**: Adhesivity. When two strips of brown gold are heated within the limits of temperature of their transformation into ordinary gold, and the strips are allowed to come in contact, they become soldered to each other. The conditions under which this phenomena takes place have been experimentally studied, and the results are given in detail.—A. **Guntz** and J. **Minguin**: Contribution to the study of the ultra-violet radiations. An account of the mechanical, physical, and chemical effects of ultra-violet light on some organic substances.—J. **Boselli**: The velocities of reactions in gaseous-liquid systems.—Daniel **Berthelot** and Henry **Gaudechon**: The comparative action of the ultra-violet rays on organic compounds possessing linear and cyclic structure. The study of mineral salts in aqueous solutions. It has been shown in earlier papers that fatty compounds are decomposed with evolution of gas under the action of the ultra-violet rays. The treatment in a similar manner of a series of aromatic derivatives has given throughout negative results; no change is effected.—R. L. **Espil**: Some new anhydrous selenites.—A. **Verneuil**: The preparation of the black enamel of the Italo-Greek potteries. The secret of the preparation of this fine enamel has been lost, and numerous attempts to reproduce it in current times have been unsuccessful. The author finds that the use of finely divided metallic iron in the coating gives a black resembling that of the ancient pottery.—Marcel **Oswald**: The action of heat upon silver nitrite.—J. B. **Senderens**: Ketones derived from phenylpropionic acid. Mixtures of phenylpropionic acid and a fatty acid, passed over a column of thoria at about 460° C., give three ketones, the two symmetrical ketones derived from the phenylpropionic and fatty acids singly, and the mixed ketone. A description is given of several new ketones prepared by this method.—Charles **Moureu** and Amand **Valeur**: The preparation of isosparteine. The action of methyl iodide on this base.—M. **Grignard**: Two new methods for the synthesis of nitriles. Chloride of cyanogen or cyanogen itself reacts with organo-magnesium compounds, giving nitriles, the necessary condition being that the magnesium compound should be added drop by

drop, and never be in excess.—Marcel **Dubard**: Remarks on the classification of the genus Sideroxylon.—J. **Granier** and L. **Boule**: The phenomena of the conjugation of the chromosomes at the prophase of the first reducing kinesis.—Raoul **Bayeux**: Experiments made at Mt. Blanc in 1910 on gastric secretion at very high altitude. The experiments were made on a dog, and showed that the quantity of gastric juice secreted in a given time, the feeding being maintained constant, diminishes in a marked manner during a stay at a high altitude. The total acidity is only slightly diminished under the same conditions. The general activity of the gastric juice is also slowed down. The bearing of these results upon mountain sickness is discussed.—H. **Agulhon**: The action of the ultra-violet rays upon diastases. Eight diastases were studied, and all of them were more or less rapidly attenuated by the radiations passing through quartz and arrested by glass.—Samuel **Lifchitz**: The sonorous reproduction of a periodic curve.—A. **Conte** and C. **Vaney**: The experimental reproduction of acephalous Lepidoptera.—E. **Roubaud**: Biological studies on the Glossina of central Dahomey.—H. **Coutière**: The ellobiopsis of bathypelagic crayfish.—Fernand **Guéguen**: Cladosporian mycosis in man. Details are given of a diseased condition in man caused by a fungus of the genus Cladosporium, the first example of a pathogenic action of a member of this genus.—R. **Robinson**: The heterotopic theory in pathology.—Louis **Gentil**: The formation of the south Riffian isthmus.—Ph. **Négris**: The existence of the Trias and Cretaceous on Mount Voidias in the north of the Peloponesus.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 23.

ROYAL SOCIETY, at 4.30.—Transmission of Flagellates living in the Blood of certain Freshwater Fishes: Miss M. Robertson.—Report on the Separation of Ionium and Actinium from certain Residues, and on the Production of Helium by Ionium: Dr. B. B. Boltwood.—The Secondary γ-Rays produced by β-Rays: J. A. Gray.—The Specific Heat of Water and the Mechanical Equivalent of the Calorie at Temperatures from 0° to 80° C. With Additional Note on the Thermoid Effect: W. R. Bousfield and W. E. Bousfield.—On the Measurement of Specific Inductive Capacity: Prof. C. Niven, F.R.S.

ROYAL INSTITUTION, at 3.—Problems of Animals in Captivity: P. Chalmers Mitchell, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Long Distance Transmission of Electrical Energy: W. T. Taylor.—Extra High Pressure Transmission Lines: R. B. Matthews and C. T. Wilkinson.

FRIDAY, FEBRUARY 24.

ROYAL INSTITUTION, at 9.—Mouvement Brownien et Réalité Moléculaire: Prof. Jean Perrin.

PHYSICAL SOCIETY, at 5.—Flames of Low Temperature supported by Ozone: Hon. R. J. Strutt, F.R.S.—The Movement of a Coloured Index along a Capillary Tube, and its Application to the Measurement of the Circulation of Water in a Closed Circuit: Dr. Albert Griffiths.—An Optical Lever of High Power suitable for the Determination of Small Thicknesses and Displacements: E. H. Rayner.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design and Construction of Works for the Bacterial Purification of Sewage: R. J. Samuel.

MONDAY, FEBRUARY 27.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Labrador: Dr. Wilfred T. Grenfell, C.M.G.

ROYAL SOCIETY OF ARTS, at 8.—Brewing and Modern Science: Prof. Adrian J. Brown.

INSTITUTE OF ACTUARIES, at 5.—The Assurance Companies Act, 1909, some Explanatory Notes on such Portions of the Act as relate to the Business of Life Assurance: A. R. Barrand.

TUESDAY, FEBRUARY 28.

ROYAL INSTITUTION, at 3.—Crystalline Structure: Mineral, Chemical, and Liquid: Dr. A. E. H. Tutton, F.R.S.

ROYAL SOCIETY OF ARTS, at 4.30.—The Resources and Problems of the Union of South Africa: The Hon. Sir Richard Solomon, K.C.B.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Modern Railway-signalling: some Developments upon the Great Western Railway: A. T. Blackall.

WEDNESDAY, MARCH 1.

ENTOMOLOGICAL SOCIETY, at 8.—Persistence of Bacilli in the Gut of an Insect during Metamorphosis: A. Bacot.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Examination of the Process of Shrewsbury and Knapp for the Estimation of Cocoanut Oil: R. Ross, J. Race, and F. Maudsley.—The Estimation of Iron by Permanganate in the Presence of Hydrochloric Acid: A. C. Cumming and A. Gemmell.—The Analysis of Sweetened Condensed Milk: A. Backe.—Note on Henry C. Frey's Method of Estimating Petroleum in Turpentine: H. S. Shrewsbury.—Note on the Formation of Hypoiodites and their Action on Sodium Thiosulphate—a source of error in certain Iodine Titrations: J. P. Batey.—New Form of Specific Gravity Apparatus: C. Butler Savory.

ROYAL SOCIETY OF ARTS, at 8.—Caisson Sickness and Compressed Air: Dr. Leonard Hill, F.R.S.

THURSDAY, MARCH 2.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Reversal of the Reflex Effect of an Afferent Nerve by altering the Character of the Electrical Stimulus applied: Prof. C. S. Sherrington, F.R.S., and Miss S. C. Sowton.—Carbon Dioxide output during Decerebrate Rigidity (preliminary communication): Dr. H. E. Roaf.—The Alcoholic Ferment of Yeast Juice. Part VI. The Influence of Arsenates and Arsenites on the Fermentation of the Sugars by Yeast Juice: Dr. A. Harden, F.R.S., and W. J. Young.—Experiments to ascertain if certain Tabanidæ act as the Carriers of *Trypanosoma pecorum*: Col. Sir D. Bruce, F.R.S., and others.

LINNEAN SOCIETY, at 8.—Dermaptera (Earwigs) preserved in Amber, from Prussia: Dr. Malcolm Burr.—Report on the Marine Polyzoa of the Collection made by Mr. J. Stanley Gardiner in the Indian Ocean in H.M.S. *Sealark*: Miss Laura Roscoe Thornely.—On the Mysidacea and Euphausiacea collected in the Indian Ocean during 1905: W. M. Tattersall.

RÖNTGEN SOCIETY, at 8.15.—Some Experiments with a 10,000 volt. Storage Battery: A. A. Campbell Swinton.

FRIDAY, MARCH 3.

ROYAL INSTITUTION, at 9.—Scents of Butterflies: Dr. F. A. Dixey, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Lagos Harbour Survey, 1909–1910: H. Ellis Hill.

SATURDAY, MARCH 4.

ROYAL INSTITUTION, at 3.—Radiant Energy and Matter: Sir J. J. Thomson, F.R.S.

MONDAY, MARCH 6.

SOCIETY OF ENGINEERS, at 7.30.—Petrol Air-gas: E. Scott-Snell.

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